THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY')

CONDUCTED BY

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"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. . . . The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

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PREFACE TO THE FIFTH SERIES.

With the present Number this Journal enters upon the fifth decennial period of its existence. The Editors, one of whom assisted at the very birth of the 'Annals,' cannot but congratulate themselves upon the continued and ever-increasing vitality of their Journal, which, notwithstanding the numerous other means of publishing Natural-History Articles that now exist, has at no previous period of its career been more abundantly supplied with good materials. This is due, no doubt, in great measure to the extreme activity which has prevailed in the investigation of all branches of Natural History during the last fifteen years; but the Editors cannot help feeling that the continued flow of valuable articles to their Journal is an indication that it is regarded as, to some extent, a particularly favourable vehicle for publication—a view which is confirmed by the fact that even Foreign Naturalists seek admission for their writings to its pages. That it may still retain this character will be the object of their earnest endeavours; and they trust it will be long before the increasing age of the 'Annals' is betrayed by any signs of decrepitude.

PREFACE.

No alteration will be made in the plan of the work, which will consist, as heretofore, of original papers on Zoological, Botanical, and Palæontological subjects, with occasional translations of foreign memoirs of importance, brief notices of new books and of the proceedings of Societies, and short notes of interesting facts and observations.

Of early contributors to the 'Annals' we have had to deplore the loss of two distinguished men during the past ten years—Dr. James Scott Bowerbank and Dr. John Edward Gray,—the latter especially, who for nearly twenty years was one of the Editors of this Journal, in the prosperity and usefulness of which he took the greatest interest, and nearly to the end of his long and valuable life enriched our pages with important contributions to various departments of zoology. Dr. Gray's place as Editor has been taken by his successor at the British Museum, Dr. ALBERT GÜNTHER, under whose auspices valuable descriptive papers which are the natural outcome of the work done in his department of the Museum will still, as formerly, find their way to the 'Annals.' One other change we have still to mention. Quite recently, from private considerations, Mr. Charles Cardale Babington, whose name has appeared on our titlepage for 35 years, expressed his wish to retire from the Editorial office; and Mr. WILLIAM CARRUTHERS, the Keeper of the Botanical Department in the British Museum, will in future act as the Botanical Editor of the 'Annals.'

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

"............ per litora spargite muscum,
Naiades, et circûm vitreos considite fontes:
Pollice virgineo teneros hic carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. 1.

No. 1. JANUARY 1878.

I.—*Observations upon Professor Ernst Haeckel's Group of the "Physemaria," and on the Affinity of the Sponges.* By W. SAVILLE KENT, F.L.S., F.Z.S., &c.

IT was scarcely to be expected that Mr. Carter would quietly surrender into Prof. Ernst Haeckel's hands, for the further exposition of his celebrated "Gastræa" theory, that interesting organism, *Squamulina scopula*, which he (Mr. Carter) a few years since pronounced, and still holds, to be a Foraminifer. The brusque and, it must be admitted, somewhat discourteous manner in which the learned professor disposes of Mr. Carter's arguments in support of the view which he adopts has also naturally led to the protest that appears in the last October number of the 'Annals.' In this protest, however, Mr. Carter does not appear to have made the most of his own position, nor, indeed, to have clearly defined the one maintained by Prof. Haeckel.

Though unable at the present moment to refer to the article which has so greatly perturbed Mr. Carter's equanimity, I was fortunate enough to obtain in May of this present year, and still have by me, a copy of Prof. Haeckel's 'Biologischen Studien,' zweites Heft, 1877, containing a chapter entirely devoted to the consideration of the so-called *Squamulina scopula* and its supposed allies. It is upon these forms collectively that the author bestows the title of the Physemaria;

and it is further evident from the quotations given by Mr. Carter that we have here word for word a reprint of the original article published in the 'Jenaische Zeitschrift.' This possession, last spring, of the volume in question enabled me to discuss at some length, in a communication to the meeting of the Linnean Society held on the 21st of June of the present year*, the views expounded by Prof. Haeckel concerning the nature and affinities of his newly created group. My communication here referred to, and of which the briefest possible notice only has so far appeared, embraces the results of investigations prosecuted during the last six years relative to that remarkable group of "collar-bearing" flagellate Protozoa whose existence was first discovered in America by the late Prof. H. James-Clark, and announced by him in the 'Memoirs of the Boston Society of Natural History,' vol. i., for the year 1866†. Four species only, representing two genera (*Codosiga* and *Salpingœca*), were here described by Prof. Clark. Later on, in the autumn of the year 1871, three out of these four types, with the addition of two new varieties, were discovered by me in the neighbourhood of London, and were duly announced at the meeting of the Royal Microscopical Society held Nov. 1 of the same year‡. With this exception these Flagellate Protozoa, as a special and independent group, do not appear, knowingly, to have fallen beneath the observation of any other investigator.

The importance that attaches itself to Prof. Clark's discoveries, however, is not associated so much with his introduction to scientific notice of a new structural type, as his simultaneous declaration that sponges were essentially composed of sociable colonies of similar collar-bearing flagellate monads. This he at the time demonstrated through an exposition of the minute anatomy of the calcareous sponge-form *Leucosolenia botryoides*, Bowerbank, and subsequently in association with a siliceous American freshwater species, *Spongilla arachnoidea*, Clark§. This last important discovery of Prof. Clark's has since been fully confirmed by the observations of Mr. Carter‖, and also by myself, as shown in my communication to the Linnean Society just quoted, in which

* "A Monograph of the Gymnozoidal Discostomatous Flagellata, with a proposed new Scheme of Classification of the Protozoa, &c."

† Reprinted in the 'Annals and Magazine of Natural History,' 4th ser. vol. i. 1868.

‡ Abstract published in the 'Monthly Microscopical Journal,' vol. vii. p. 261, 1871.

§ 'Silliman's American Journal,' December 1871; reprinted in the Ann. & Mag. Nat. Hist. for January 1872.

‖ Ann. & Mag. Nat. Hist. vol. x. July 1871.

I am enabled, through my extended researches into the structure and developmental history of the independent collar-bearing forms, to follow out the subject to a more decisive issue than has yet been attempted.

Prof. Haeckel, as it is well known, while driven to admit the existence in sponge-structures of these collar-bearing cells or monads, has altogether refused so far to recognize in each such collar-bearing monad a distinct and individual vitality, choosing rather to regard the same as the contiguous cellular constituents of one out of two multicellular layers or tissues of which he considers all sponge-forms are composed. This view held by Haeckel would, if correct, approximate the sponges more closely to the simplest tissue-forming Cœlenterata; and it is exactly such a position for them that he has been endeavouring for some years past to bring into general recognition. Taking upon trust, indeed, and dazzled by the garish lustre of the learned professor's brilliant "Gastræa" theory, of which the "Cœlenteric" or "Diploblastic" interpretation of the sponge question must be regarded as the chief corner-stone, that recognition has already been very extensively accorded, leaving, indeed, as a very slender minority the adherents of the Protozoic or Monoblastic interpretation of the organisms in dispute. An irreparable gap has further been occasioned here through the recent deplorable death, in the midst of his valuable investigations, of Prof. H. James-Clark. The time at length, however, seems to have arrived when accumulated facts of so substantial a nature can be set in array in proof of the thorough agreement of the sponges in every essential detail with the representatives of the ordinary Protozoa, that the acceptors, upon trust, of the Diploblastic interpretation of the question will be well advised to reexamine and work it out for their own satisfaction. If upon so doing the results realized should accord with and confirm those obtained by the writer, the "Diploblastic" or "Gastræa" theory, so far, at least, as the sponges are concerned, will be held henceforth in but scant estimation.

The grounds upon which the above, at first sight somewhat presumptuous, anticipation is hazarded, together with the bearings upon the question of Prof. Haeckel's newly created group of the Physemaria (embracing, in his opinion, Mr. Carter's Foraminiferal (?) type *Squamulina scopula*), may now be examined. Before arriving at this more complex aspect of the problem, however, it is desirable to devote a brief space to an acquaintance with the initial integers of it, viz. the independent collar-bearing flagellate monads in their simplicity, as first made known to us by Prof. Clark. On reference to my

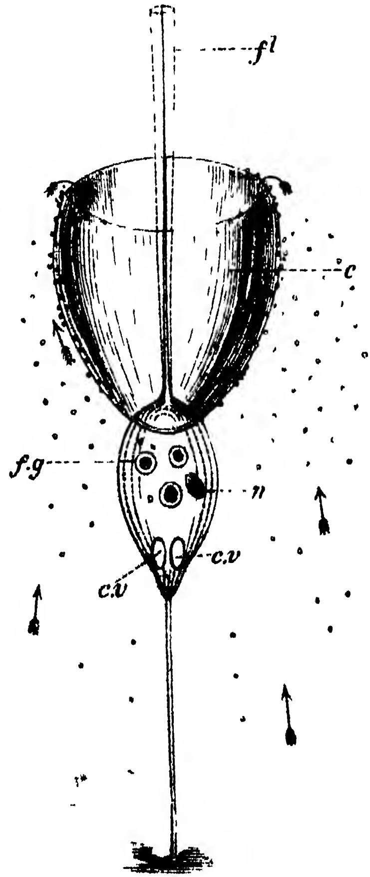
communication, already quoted, it will be found that the record of nearly forty well-marked species, in place of the original four, has been the reward of my several years' study of this interesting group; and concerning the general structure, functions, and developmental history of these I am enabled to supply perfectly original and important data. To those acquainted with the writings of Prof. Clark, the general aspect of these typical "collar-bearing" monads will no doubt be familiar; but for the advantage of those who are not, they may be described as ovate, pyriform, or flask-shaped animalcules, stalked, sessile, or floating freely in the water, naked or enclosed within a transparent lorica, and either solitary or forming extensive colonies—the chief and common characteristic of all these being that each individual is adorned anteriorly with an exquisitely delicate funnel-shaped sarcodic expansion, the "collar," from the centre of the area enclosed by the base of which a single long flagellum takes its origin. All the species as yet discovered are of so minute a size, the body of the largest not exceeding the 1200th part of an English inch in total length, and usually being much smaller, that a magnifying-power of at least 500 diameters is requisite for their satisfactory investigation. This last circumstance, no doubt, readily accounts for the immunity from attention that they have hitherto enjoyed, they, on the other hand, being so abundantly distributed in both salt and fresh water that scarcely a fragment of weed can be examined from either of these two sources, by those once familiar with their appearances, and employing a sufficiently high magnifying-power, without the encounter of some one or even several types.

Among the most important results of my investigations of this interesting and, as is now shown, exceedingly extensive group is the satisfactory elucidation of the true nature and position of the oral aperture or mouth, and of the structure and function of the hyaline funnel-shaped "collar." Prof. Clark left both these points in a very unsatisfactory state, he, in the first place, being altogether unable to determine the exact aspect and position of the oral aperture, but hazarding the opinion that it lay somewhere within the collar and near the base of the flagellum. Concerning the nature and uses of the funnel-shaped "collar" itself he makes no suggestion and furnishes us with no clue. By prolonged and repeated observation, however, I have been able most conclusively to demonstrate that food is ingested at any point within the area embraced by the base of the hyaline collar, the whole of which area must therefore necessarily be characterized as the

oral or inceptive one. Digested and other effete particles are likewise, I have ascertained, usually passed off from the same circumscribed surface. The function and properties of the hyaline "collar" I have found to be almost inconceivably remarkable. By the employment of an amplifying power of from 800 to 1000 diameters it was revealed to me that this collar consisted of an exquisitely delicate film of sarcode, capable of expansion and retraction at the will of the animalcule—to such an extent, indeed, that it might be quite withdrawn into the substance of the body. In this structure a circulating stream was constantly in motion, ascending on the outside and descending on the inside, and identical in all ways with those circulating sarcode-streams characteristic of the extended pseudopodia of certain Radiolaria. Placing comminuted carmine in the water, this collar with its circulating current, assisted by the active movements of the flagellum, was found to constitute a wonderful and most admirably constructed trap for the purpose of drawing towards it and arresting passing particles of food. The phenomenon presented by this trap in active action was as follows:—The rapid rotatory action of the flagellum impelling swift currents of water to flow from behind in a forward direction, caused all floating particles carried with it to impinge upon some point of the surface of the expanded collar. Adhering here, these particles were now carried on by the motion of the substance of the collar, and after ascending the outer surface, surmounting the rim, and descending upon the interior surface of the structure, became engulfed in the soft sarcode of the animalcule's body embraced by the collar's base. The accompanying woodcut (p. 6) illustrates clearly and in a diagrammatic manner the remarkable phenomena that accompany the feeding-process.

In relation to the life-history and reproductive phenomena of this interesting collar-bearing group, I have satisfactorily ascertained that while that simple fissiparous method of multiplication common to all ordinary Protozoic organisms extensively prevails, a process of encystment and resolution of the entire body into granular germs or spores also plays an important part. The withdrawal by the adult individual of the characteristic hyaline collar, and its extension of pseudopodic processes, have likewise been frequently observed, these phenomena being intimately associated with the function of reproduction. The larval or initial condition of the collar-bearing Flagellata derived from the reproductive process is more simple in structure than the parent from which it sprung, it in some instances taking the form of an Amœba and in others that of a simple flagellate monad. Taken as a whole, my

investigation of the life-history of this collar-bearing group has yielded data abounding with evidence confirmatory of and llel with that obtained by Messrs. Dallinger and Drysle relative to the life-history of the more simple *Cercomonads*, published at length in the 'Monthly Microscopical Journal' for the years 1873–74, some of the same having



Monosiga gracilis, S. Kent.

A solitary Gymnozoidal Discostomatous Protozoon feeding on comminuted carmine: *c*, collar; *n*, nucleus; *fl*, flagellum; *c.v*, contractile vesicles; *f.g*, food globules. The arrows indicate the direction of the current caused by the rotatory motion of the flagellum, and the course taken by the food-particles on striking against and adhering to the collar. The dotted line on each side of the flagellum marks the arc described by its rotation. × 2000 diameters.

been accumulated by me prior, and some subsequent, to the appearance of their very valuable contributions to our knowledge of these lowly organized types.

My prolonged investigation of these hitherto little-known collar-bearing flagellate monads, together with a careful study of all other forms most closely approaching these in structure,

has in the end forced upon me not only the unavoidable necessity of coining for this particular group a special classificatory title; it has at the same time been suggestive of an entirely new and simple scheme of reclassification, or redivision into primary sections, of the entire Protozoic subkingdom. This latter object I have proposed to attain by taking as a basis for diagnosis the nature and extent of the oral or inceptive area. Thus, for instance, among an exceedingly extensive group of the Protozoa, embracing practically all the representatives of the Rhizopoda and certain Flagellata, it will be found that there is no especial mouth-aperture, food-particles being engulfed indiscriminately by the soft, yielding sarcode at any point on the surface of the periphery. These organisms are, in fact, in all parts and everywhere mouth, and represent the simplest or most degraded types of the whole subkingdom. In reference to this dispersed character of the inceptive surface I have proposed for this section the title of the "HOLOSTOMATA*". Advancing a little further we find a group in which, although the oral or inceptive areas have become distinct and specialized, they are at the same time multifarious and distributed over a considerable extent, if not over the whole, of the surface of the body. This class or section is represented by the Acinetina or Suctoria, a group in which the modification into tubular sucking-mouths of the pseudopodia of the preceding Holostomatous type is at once apparent. For these many-mouthed forms I have proposed the title of the POLYSTOMATA. With the next step forward we are brought face to face with that assemblage of collar-bearing flagellate forms that constitute the chief subject matter of this communication. Here, as already shown, there is a considerable advance upon the two preceding types; for the inceptive area, although not yet attaining to the importance of a distinct and definite mouth, is no longer scattered over the general surface of the body, but is concentrated and confined to the *anterior* extremity. In reference to the discoidal form of this anterior inceptive area, bounded, as already shown, by the base of the funnel-shaped collar, I have proposed the title of the DISCOSTOMATA. The fourth and most specialized group of the Protozoa includes the typical Ciliate and Flagellate Stomatode Infusoria, which may be collectively distinguished by the title of the MONOSTOMATA or EUSTOMATA.

A brief space may now be devoted to an examination of the claim of the members of the sponge tribe for admission into the ranks of one or other of the four Protozoic classes or subdivisions above enumerated. As mentioned in a preceding

* [Already used in Mollusca, and hardly bearing the signification here given to it.—EDS.]

page, Prof. H. James-Clark was the first authority to point out the resemblance between the essential flagellate units of the sponge-body and the independant collar-bearing monads, of which he was the discoverer, these results, so far as relates to the possession by the sponge-monads or Spongozoons of similar membranous collars, being confirmed by the observations of Mr. Carter. It was clear, however, that it could only be through a much more extended and accurate acquaintance with the independent Discostomatous or collar-bearing forms that this question of the natural affinities of the sponges could be definitely and satisfactorily set at rest. It was entirely actuated by the ambition to become possessed of such accurate and extended information that the writer has devoted the last six years to the study of this particular group; and it is only fortified with the substantial fruits of this prolonged investigation that he now approaches the obscure question of the nature and affinities of the sponges. Full details in reference to these investigations will appear in due course; but it may be briefly stated here that a careful examination of members of each of the leading sponge-orders, Calcareous, Siliceous, and Keratose, has pointed to one and the same general conclusion—namely, that sponges can no longer be regarded logically in any other light than as typical Discostomatous Protozoa. Not only in all structural points and in the remarkable form and function of the hyaline collar is the correspondence complete, but the phenomena of reproduction and development are likewise essentially identical with what has already been observed of the simple and independent collar-bearing types. The only essential distinction between the sponges and these last-named forms is, in fact, that while the latter, whether fixed or floating, solitary or aggregated in social clusters on a simple or branching pedicel, are invariably naked and fully exposed to view, the collar-bearing flagellate monads of the sponge-colony are as invariably concealed by and immersed within a sarcodic and usually spiculum-secreting matrix. Practically, the distinction between the two groups is essentially parallel with what obtains between the solitary or social "naked" Tunicata, *Ascidiadæ* and *Clavellinidæ*, and those compound colony forms, the *Botryllidæ*, which are immersed and concealed within a gelatinous and not unfrequently spiculiferous matrix. And yet no one in his right senses would think of calling in question the propriety of uniting these two as members of the same primary class of the Molluscoida. In a similar manner it is requisite to unite as members of the same Protozoan class of the Discostomata the naked and independent collar-bearing

monads, *Codosiga* and *Salpingœca*, and those socially immersed, the sponges, in a sarcodic matrix. For convenience' sake I have proposed to distinguish these two respective sections or subclasses as the Discostomata Gymnozoida and Discostomata Sarcocrypta.

While at first sight a sponge-body, or Sarcocryptal Discostomatous colony, appears to present an almost incomprehensibly complex type of organization, it will be found on close investigation, assisted by an intimate acquaintance with the Gymnozoidal Discostomatous group, to be reducible to three, or even less, very simple elements. The first and most essential of these is necessarily represented by the collar-bearing monads, the second by the simple *Amœba*-like cell-elements or cytoblasts, and the third by the general investing sarcode or syncytium. These three elements intelligently recognized, or even the first and last only, all remaining structural details are most easily comprehended. Regarding, in fact, the collar-bearing monads as the one essential element of the sponge to which all the other structures are subsidiary, the investing sarcode or syncytium may be described as furnishing, in the first place, a gelatinous fulcrum or basis for the reception and support of the essential monads, and, in the second, a suitable nidus or matrix for the nurture and development of their offspring or reproductive products. To this last-named category, indeed, may be referred the *Amœba*-like cytoblasts and all the remaining larger or lesser granular contents of the syncytium. This explanation of the sponge-structure is offered not as a crude theory, but as the result of direct personal investigation, in the course of which the development of what at first sight appeared as mere granular specks, first into *Amœba*-like bodies, and then onwards into the characteristic adult collar-bearing monads, was actually witnessed by me, as also the reassumption by these adult monads of an amœboid state, their coalescence or fusion with neighbouring individuals, and final breaking up into innumerable germs or spores similar to those from which they originally sprang. The whole life-cycle is in fact perfectly identical with what obtains among the gymnozoidal section of the class and all other simple monad forms, with the single difference that the reproductive germs, instead of being dispersed into the surrounding water, are retained by, and grow up within, the substance of the syncytium.

Although the method of increase above recounted represents the normal process of development among the sponges, there are certain departures from this simple formula which require a special explanation. The most important of these, and one,

indeed, that has considerably exercised the mind of every authority who has devoted his energies to the solution of the "sponge-question," is associated with the so-called ciliated germs or larvæ of certain sponge-forms. This "ciliated larva," which may in fact be regarded as the veritable "*pons asinorum*" of the whole sponge-problem, has been seized upon and trotted round the lists by Prof. Haeckel and all the supporters of the Diploblastic or Cœlenteric theory of sponges as the perfect embodiment of the typical sac-shaped bilaminate Gastræa, or the hypothetical stock-form of all animal life from the Cœlenterata upwards, and as conclusively proving in its own personality the necessity of regarding sponges as members of the Cœlenterate subkingdom. Put crucially to the test, however, it will be found that these ciliated sponge-germs are altogether innocent of the blushing honours that have been so forcibly thrust upon them.

As already shown by Metschnikoff*, these somewhat remarkable bodies by no means conform, in either external characteristics or in the fashion of their development, to that arbitrary formula which has been insisted upon by Prof. Haeckel, and which was necessary for the vindication of his position. It may be further demonstrated now, however, that there is no structural or functional aspect associated with these bodies that does not find its parallel among the more simple and typical Protozoa, or that cannot be readily explained by reference to the phenomena manifested by the various members of that group. The only clue to a thorough comprehension of the nature of these ciliated bodies is, as might be expected, afforded by the study of their development. This has been followed out by me in association with *Grantia compressa*, *Sycon ciliatum*, and other sponges prominent for their plentiful production of these disputed structures, the evidence adduced in all cases, as detailed and illustrated elsewhere, overwhelmingly indicating that they cannot be regarded otherwise than as the results of a specially modified process of multiple fission, and that their correct title would be "compound gemmules." Among the ordinary Holostomatous Protozoa such a mode of multiple fission following the coalescence or fusion of two or more individuals is of frequent occurrence, the only point of departure between the two cases being that, whereas in the sponges the individual resultants of such multiple fission remain in intimate connexion with one another, in the more simple and independent forms, as remarked of their germs, they become separated and dispersed through the

* 'Zeitschrift für wissenschaftliche Zoologie,' Bd. xxiv. 1874; and Ann. & Mag. Nat. Hist., July 1875.

surrounding water. Taken in its most highly characteristic phase, this compound gemmule, or wrongly called "ciliated larva" of the sponge, represents a spherical or ovate aggregation of typical collar-bearing monads or spongozoa, connected laterally and by their bases with one another, and with their anterior flagellate and collar-bearing extremity directed outwards. In this condition they, in fact, present a wonderful resemblance to a social colony of one of the simpler Gymnozoidal types, and might be directly compared to a detached capitulum of the pedicelled genus *Codosiga*, Jas.-Clk., or to a spherical colony of the free-floating genus *Astrosiga*, S. Kent. It is only when certain of these sponge-monads withdraw their characteristic collars and commence to throw off and secrete around them the spiculiferous syncytium as a nidus for the further development of the colony that their true sponge nature becomes apparent. This brief chapter of their developmental history brings out in high relief the potential importance of the collar-bearing monads compared with the remaining elements of the sponge community, showing, indeed, as already intimated, that these latter are entirely subordinate to and derived from these essential sponge-units.

The compound ciliated gemmules, whose true nature has just been discussed, are most abundantly encountered in association with the calcareous division of the sponge tribe. With certain of these forms, but more especially among the siliceous group, other compound ciliated bodies occur, concerning which, although it has not been hitherto attempted, a very similar interpretation may be rendered. Reference is here made to those spherical ciliated chambers that first received from Mr. Carter the title of "ampullaceous sacs." By Prof. Clark they have been denominated the "monad-chambers;" and in those sponge-types where they are present they seem, so far as has been observed, to embrace the whole and entire system of the collar-bearing monads, each such chamber in its normal and fully developed state being completely lined, except at its point of communication with the general aquiferous system, with these essential spongozoa. The examination by me of a species of *Desmacidon* revealed the presence of these ciliated chambers in great profusion and in every phase of their development. It was further elicited, by a careful study of the earlier stages of the same, that they take their origin by a process of multiple fission in all ways identical with what has been followed by the detached compound gemmules. Both present in their initial stage a morula-like aspect, the subsequent and essential point of departure being that, while in the latter case the free-swimming ciliated gemmule has the collar-

bearing and flagellate extremity of the individual monads directed exteriorly, in the ampullaceous sacs or monad-chambers they are directed towards the interior of a central cavity. Full details, with illustrations, of the examples that have led to this interpretation of the "ampullaceous sac" accompany my recent communication to the Linnean Society.

The bearing upon the whole question of Prof. Haeckel's newly created group of the Physemaria may now be approached. In Haeckel's own words (*l. c.* pp. 172 and 178), the several types to which this title of the Physemaria is collectively applied are characterized as being neither true sponges nor true polypes, but as "eine kleine Gruppe von niedersten Pflanzenthieren, die der hypothetischen Stammform aller Metazoen, der Gastraea, näher stehen, als alle anderen bis jetzt bekannten Thiere." Or, as elsewhere intimated, he recognizes in this group the almost perfect embodiment of the hypothetical "Gastræa," upon which the whole superstructure of his celebrated Gastræa theory is founded! Altogether Prof. Haeckel relegates to his newly founded group two generic and seven specific types, the aspect and structural characteristics of which, as described and illustrated by him, may now be examined. The first of the two genera (*Haliphysema*) is already familiar, the name having been conferred by Dr. Bowerbank, in his 'Monograph of the British Spongiadæ,' on two minute forms which he regarded as the smallest and simplest of known sponge-types; the second genus (*Gastrophysema*, Haeckel) exhibits a slight advance in complexity of structure upon the preceding genus. Represented in their simplest condition (*Haliphysema primordiale* et *echinoides*, Haeckel), and necessarily closest approximation to Prof. Haeckel's hypothetical "Gastræa," these Physemaria may be described as minute spherical or ovate bodies elevated on a pedicel and bristling externally with adhering fragments of sponge-spicules, grains of sand, and other extraneously derived particles. Interiorly there is found a single hollow chamber opening anteriorly by a simple constricted terminal aperture. The most interesting and important feature of these organisms is now arrived at. By Prof. Haeckel's own description and drawings it is shown that the entire lining surface of the simple interior cavity is represented by a single and continuous layer of collar-bearing cells identical with those that constitute the essential living units of ordinary sponge-structures, or of the independent Gymnozoidal Discostomatous group already described. The outer wall is composed of a syncytial element similar to that of typical sponges, with the exception that, instead of secreting a spicular or other skeleton of its own, it draws together and appro-

priates for a similar use such foreign particles close at hand as may be of a convenient size and form. Prof. Haeckel refuses at present, as in the case of ordinary sponge-structures, to recognize in the collar-bearing-monad lining any thing of less high organization than a true cellular membrane or tissue, comparable to ordinary ciliated epithelium, each collar-bearing flagellate monad being, in his opinion, indeed, a mere cell unit. That we have here, however, as, judging from their broad external characters only, Dr. Bowerbank was the first to decide, a true sponge or sarcocryptal Discostomatous Protozoon, there cannot be the slightest doubt. It may be further maintained that *Haliphysema* not only represents the simplest sponge-type that has yet been discovered, but one in which is found epitomized, with but slight modification, the simple monad-lined "ciliated chamber" or "ampullaceous sac" of the more complex groups referred to at length on a preceding page. The developmental phenomena of the *Haliphysemata*, as indicated by Haeckel's figures and description, are entirely in accord with those of the ordinary sponges—compound ciliated gemmules, the result of multiple fission, being produced, which agree in form and structure with those of *Sycon*, *Grantia*, and other sponge-types. The genus *Gastrophysema* differs from *Haliphysema* only by having several intercommunicating internal chambers instead of one, the two, in fact, bearing the same relationship to one another that the many-chambered foraminiferal genus *Nodosaria* does to the single-celled *Lagena*. The exceedingly slight and artificial grounds upon which the discrimination between two such closely approximating types is based, each having necessarily represented the single-chambered type at one period of its growth, totally unprepares one for the account Prof. Haeckel has to render of *Gastrophysema dithalamium*, Haeckel, the simplest and typical representative of his second genus.

Here verily Haeckel has out-Haeckeled Haeckel, and, carried away by the ardour of his devotion to the "Gastræa" theory, lost all command over the reins of his very fertile imagination! Having observed that the ciliated germs and amœboid masses (his so-called ova) in the example he examined were, as might be rationally anticipated, represented most abundantly in the posterior or older-formed of the two chambers, he at once takes for granted that the functions of reproduction are specially relegated to this chamber, and, with characteristic confidence in the strength of this bare assumption, bestows upon it the title of the "Bruthöhle oder Uterus." The upper or anterior of the two chambers he invests with the functions of a true stomach ("Magenhöhle"), while the terminal aperture of

this chamber, as also the single one of *Haliphysema*, he regards as a true mouth or oral aperture ("Mundöffnung"). Having further observed some peculiar pyriform bodies scattered among the ordinary flagellate cells that line the anterior chamber, he sees, or rather imagines he recognizes, in these, rudimentary glandular structures, or, to use his own expression, "Drüsenzellen." From the figures of these so-called "gland cells" which accompany his description, however, it is very evident that we have here simply an "encysted" condition of certain of the ordinary collar-bearing monads, already ascertained by me to occur among the ordinary sponges, and which in this instance, regarded separately, harmonizes remarkably with a similar encysted condition of the solitary Gymnozoidal species *Salpingœca fusiformis*, S. Kent, comparisons between which may be instituted in the illustrations that accompany my monograph of this group.

Such being the wonderfully complex organism that Prof. Haeckel constructs out of this simple little two-chambered sponge, the mind trembles with awe at the thought of what he might have conjured out of the three-, four-, or five-chambered species, *Gastrophysema scopula*, Hkl., = *Squamulina scopula*, Carter, had he had an opportunity of examining that species in the flesh. As suggested elsewhere, with every additional chamber he would probably have discovered and associated some new sensory organ, until in the most complex type a perfect embodiment of the five primary senses might have been made manifest. Under existing circumstances, however, Prof. Haeckel is obliged to content himself with enumerating its external characters as given by Mr. Carter, and with taking that authority smartly to task for the interpretation he has given of the structure. Under any circumstances, the conclusions arrived at by Mr. Carter concerning the true nature of this debatable organism are far more logical than his own, he (Mr. Carter) having, without doubt, referred the structure to its right subkingdom, that of the Protozoa. That Mr. Carter, in witnessing the protrusion of the pseudopodia from the terminal orifice of the type in question, should have decided upon its foraminiferal nature is perfectly comprehensible. Even as a true sponge, agreeing in all structural details with the simple *Haliphysemata* here described, we should expect to find the sarcode or syncytial element protruded in such a fashion for the seizing of the fragmentary foreign particles out of which it builds up instead of secreting, as do ordinary sponges, a protective and supporting framework. If, on a closer investigation, Mr. Carter finds the internal cavity lined with the characteristic collar-bearing monads, it may be anti-

cipated that no one will be more ready than himself to recognize in it a true though wonderfully simple sponge-type. If, on the other hand, he should find it to consist of homogeneous sarcode, it is not identical with Prof. Haeckel's *Gastrophysema*, and his first inference, that it must be regarded as a true Foraminifer, or, at all events, a Rhizopod, is correct.

Notwithstanding the remarkable interpretation placed by Prof. Haeckel upon the interesting and simple little sponge-forms which have received from him the title of the Physemaria, that authority has undoubtedly greatly advanced our knowledge of the Protozoa by his record (so far as structural *facts* only are concerned) and exquisite illustrations of those types which have been examined by him. In the faithful rendering of the minutest histiological detail his pencil certainly has no equal, every stroke speaking to those familiar with the object or structure depicted with an amount of eloquence that words would fail to inspire.

In conclusion, it may be predicated that, if Prof. Haeckel would only recognize in each collar-bearing cell of his exquisite drawings that individuality which it is impossible after a long acquaintance to deny them, we should hear no more of the "Gastræa" theory in association with the sponges. That the chief if not the only obstacle to his yielding such recognition exists through his unacquaintance with these collar-bearing cells in their living and active state, forces itself upon one's mind in contemplating all his illustrations of these structures that occur both in his magnificent 'Monograph of the Calcareous Sponges' and the volume containing his description of the Physemaria. In not a single instance out of these is the characteristic "collar" portrayed in that symmetrical and fully expanded condition which so eminently distinguishes it in the living state. Nor on any occasion has Prof. Haeckel indicated the presence of the invariably two or more rhythmically expanding and contracting vesicles always to be observed in the living monads, and which in these types, as among all other Protozoa, represent the rudimentary respiratory system. His representation of the nucleus of these separate bodies is also by no means life-like, but presents all the features of a *post mortem* aspect. A careful investigation of this special structure has, in fact, clearly demonstrated that it is by no means a constant and essential factor of any Protozoan organism, not being, indeed, the equivalent of the nucleus of ordinary tissue structure, but merely an accessory to the reproductive act. The probability of this element being subservient only to this function of reproduction, and of its not being comparable to the typical histiological nucleus, has been already suggested

by Prof. Huxley*; while the inconstancy of its occurrence among even the higher Protozoa at once demonstrates the artificial character of the group of the Monera, founded by Haeckel for the reception of those forms in which a nucleus has not yet been recognized. If, as is here intimated, the collar-bearing monads of the sponge-colony have only been examined by Prof. Haeckel in a dead and preserved state, with all the exquisitely beautiful phenomena of life suspended, it is not to be wondered at that he has passed them by as the mere individual cell elements of an epithelium-like tissue. But should he make himself acquainted with the same when alive, and note, as has been done by the writer, the circulating sarcode stream of the expanded "collar," the food intercepted by it, and, after traversing the outer and inner surface, engulfed within the substance of the sarcode at its base, then collected into pellets and regurgitated through the substance of the body in a manner identical with the food-circulation of the higher infusorial types, such as *Vorticella*—witnessing at the same time the constant pulsating action of the contractile vesicles and all the phenomena attending the several reproductive processes—he will scarcely disallow any longer their title to individual and independent recognition.

Respecting the position, in reference to the ordinary sponge-forms, that the single-chambered non-spiculiferous Physemaria occupy, it is very evident that they so far differ from such ordinary types that they cannot be correctly styled, with their single oscular aperture and no trace of pores, representatives of the "PORIFERA." The discovery of these new and interesting forms makes it necessary, indeed, to effect a slight modification of the usual classificatory system. Rejecting the old title of the Porifera, the group may be more conveniently divided now into two primary sections—one known as the "POLYTREMATA," to include all the ordinary poriferous sponges, and a second, to be distinguished as the "MONOTREMATA"†, for the reception of all those simple and single-apertured types of which the genera *Halyphysema* and *Gastrophysema* constitute the characteristic representatives. A little later, not improbably, a third section, equivalent in value to these two, may have to be instituted, under the title of the "ATREMATA." This type would have no internal cavity, and consequently no aperture or pores, the collar-bearing monads, with their bodies immersed in a syncytial basis, opening directly on the water. Such a type seemed to have

* Prof. Huxley "On the Classification of the Animal Kingdom," Journal of the Linnean Society, vol. xii. p. 205, 1875.

† [Already used for an order of Mammalia.—EDS.]

been already furnished by the genus *Phalansterium*, Cienkowski, as reported by Prof. Clark*; but a reference to the original description and illustration in Schultze's 'Archiv,' Bd. vi. S. 4, 1870, has elicited that this colony form is composed of the more simple flagellate Holostomatous monads, and not of the collar-bearing or Discostomatous varieties. Should this missing link be discovered, it will, while closely related to and forming a natural group of the true sponges, occupy the same relation towards the Gymnozoidal or free and independent Discostomatous types as the social and slime-immersed genus *Ophrydium* does to *Vorticella*, *Vaginicola*, or other naked and solitary representatives of the higher ciliate order of the Infusoria.

4 Marine Terrace, St. Helier's, Jersey,
Oct. 12, 1877.

II.—*Notices of British Fungi.* By the Rev. M. J. Berkeley, M.A., F.L.S., and C. E. Broome, Esq., F.L.S.

[Continued from ser. 4. vol. xvii. p. 145.]

[Plates III. & IV.]

1631. *Agaricus* (Amanita) *magnificus*, Fr. Hym. Eur. p. 25; Fl. Dan. t. 2146.

In fir-woods. Glamis, Rev. J. Stevenson, no. 707.

Our plant differs from the figure quoted above in having a bulbous base.

Pileus campanulate, even, with scattered mealy patches; stem attenuated upwards, transversely scaly. Whole plant dark liver-red, with the exception of the white adnexed gills. Allied to *A. rubescens*, but quite distinct, though variable. Fl. Dan. tab. 2148. fig. 2, which is referred by Fries to this species, has, like the agaric before us, a bulbous base. The wartless variety of *A. muscarius* occurred last autumn more than once at Coed Coch, and was very beautiful.

1632. *A.* (Lepiota) *rhacodes*, subsp. *puellaris*, Fr. Hym. Eur. p. 29.

In woods. Coed Coch. Not uncommon.

1633. *A.* (Lepiota) *biornatus*, B. & Br., Journ. Linn. Soc. xi. p. 502.

In great abundance in a melon-frame, Arthingworth,

* Silliman's 'American Journal,' Feb. 1871; Ann. & Mag. Nat. Hist. March 1871.

Northants, July 8, 1876. Exactly agreeing with the Ceylon specimens, except that the gills are not ventricose.

1634. *A.* (Lepiota) *seminudus*, Lasch.; Fr. Hym. Eur. p. 38.

King's Lynn, Mr. Plowright. A very delicate little plant.

**A.* (Lepiota) *gliodermus*, Fr. Ic. t. 15. fig. 1.

Perthshire, Dr. Buchanan White.

1635. *A.* (Armillaria) *hæmatites*, B. & Br. Pileo hemisphærico jecorino sicco hispidulo; stipite concolori deorsum incrassato, solido; annulo spongioso; lamellis breviter decurrentibus.

Amongst fir-leaves. Glamis, Rev. J. Stevenson.

Pileus about 1 inch across; stem 2 inches high, $\frac{1}{4}$ inch thick at the base; ring scaly beneath.

We cannot point out any species to which it is allied. Like *A. subcavus* it is analogous to *Lepiotæ*.

1636. *A.* (Tricholoma) *cerinus*, Pers. Syn. p. 321; Fr. Ic. t. 39. fig. 1.

On a lawn. Ballinluig, Rev. J. Stevenson, no. 902.

The yellow gills, contrasted with the brown pileus, make it a very pretty species. The pileus in our specimens is brown, which seems to be the more usual colour; but it is sometimes yellow.

**A.* (Tricholoma) *tigrinus*, Schæff. t. 89; Fr. Ic. t. 41 *inf.*

Rev. J. Stevenson, no. 900. On the sea-shore.

Allied to *A. gambosus*.

It varies a good deal in the scaliness of the pileus. Mr. W. S. Smith's plant from Reigate is presumably the same; but ours can scarcely be called fœtid (Cooke, Handb. p. 33).

1637. *A.* (Clitocybe) *socialis*, Fr. Ic. t. 49. fig. 2; Hym. Eur. p. 83.

Amongst fir-leaves. Downton, Herefordshire. Hereford Fungus Show, 1876.

1638. *A.* (Clitocybe) *amarella*, P.; Fr. Hym. Eur. p. 84.

In woods. Coed Coch, Oct. 19, 1876.

The taste is bitter and disgusting, the smell that of prussic acid.

1639. *A.* (Mycena) *rubro-marginatus*, Fr. Hym. Eur. p. 132.

Var. *fusco-purpureus*, Lasch.

Amongst dead leaves. East Farleigh.

Very distinct from the usual form, having much the appearance of an exotic *Marasmius*.

1640. *A.* (Mycena) *Zephirus*, Fr. Ic. t. 78. fig. 6; Hym. Eur. p. 133.

On decayed wood. Rev. J. Stevenson. Rose-coloured.

**A.* (Mycena) *parabolicus*, Fr. Ic. t. 80. fig. 3.

On decayed wood. East Farleigh, Sept. 13, 1876.

**A.* (Mycena) *atro-cyaneus*, Batsch; Fr. Hym. Eur. p. 141.

On the ground. Glamis, Rev. J. Stevenson.

1641. *A.* (Mycena) *plicosus*, Fr. Ic. t. 81. fig. 4; Hym. Eur. p. 142.

Killin, Rev. J. Stevenson.

1642. *A.* (Mycena) *amictus*, Fr. Ic. t. 82. fig. 3; Hym. Eur. p. 144.

Amongst leaves. Glamis, Rev. J. Stevenson.

1643. *A.* (Omphalia) *hydrogrammus*, Fr. Ic. tab. 71; Hym. Eur. p. 154.

Coed Coch, Oct. 1876.

1644. *A.* (Omphalia) *umbilicatus*, Schæff.; Fr. Ic. t. 73. fig. 1; Hym. Eur. p. 155.

Amongst moss. Perth, Dr. Buchanan White.

1645. *A.* (Omphalia) *maurus*, Fr. Ic. tab. 73. fig. 2; Hym. Eur. p. 156.

On lawns. Coed Coch.

1646. *A.* (Omphalia) *striæpileus*, Fr. Ic. t. 73. f. 3; Hym. Eur. p. 157.

Amongt moss and leaves. Glamis, Rev. J. Stevenson.

1647. *A.* (Omphalia) *pictus*, Fr. Ic. t. 77. fig. 4; Hym. Eur. p. 163.

Killin, Rev. J. Stevenson.

**A.* (Pleurotus) *mutilus*, Fr. Syst. Myc. i. p. 191; Ic. tab. 88. f. 4.

Perthshire, Dr. Buchanan White.

1648. *A.* (Pleurotus) *reniformis*, Fr. Ic. t. 89. fig. 3; Hym. Eur. p. 177.

On branches of silver fir. Glamis, Rev. J. Stevenson.

1649. *A.* (Leptonia) *æthiops*, Fr. Ep. p. 152; Ic. t. 97. fig. 3.

Perthshire, Dr. Buchanan White. Glamis, Rev. J. Stevenson.

1650. *A.* (Nolanea) *fulvo-strigosus*, B. & Br. Pileo conico griseo rugulosa; stipite tenui furfuraceo-squamuloso, basi strigis lateritiis hispido; lamellis adnatis griseis.

On the ground in a wood, near *Cortinarius Bulliardi*.

East Farleigh, Sept. 13, 1876.

Pileus ¾ inch across, ½ inch high; stem 2 inches high, about 1 line thick, clothed at the base with rigid red hairs and tinted with the same colour above. Spores ·0005 long, ·0003 broad. The peculiar character of the strigæ separates this from all other species.

1651. *A.* (Eccilia) *nigrella*, Pers. Syn. p. 463.

Perthshire, Dr. Buchanan White.

This appears to be quite distinct from *A. atrides*; the stem is not nigro-punctate above, nor are the gills nigro-denticulate.

1652. *A.* (Pholiota) *Vahlii*, Schum., in Fl. Dan. t. 1496; Fr. Hym. Eur. p. 214.

On the grassy banks of the railroad. Inver, Dunkeld, Mr. M'Intosh.

Fries makes this a variety of *A. aureus*. Our plant is exactly that of the 'Flora Danica.'

**A.* (Pholiota) *terrigenus*, Kalkb.

Ballinluig, Rev. J. Stevenson, no. 960.

1653. *A.* (Inocybe) *dulcamarus*, Pers. Ic. pict. tab. xv. fig. 2.

On the ground. Pass of Killiecrankie, Rev. J. Stevenson, no. 950.

We suppose this to be the plant of Persoon, at least that figured in the 'Icones;' but as the gills are peculiar we think it better to give a description.

Pileus convex, umbonate, umber, clothed with adpressed fibres, the centre breaking up into areolate patches, about $\frac{1}{3}$–$\frac{1}{2}$ inch across; stem 1 inch or more high, 1 line thick, of the same colour as the pileus, scaly below, tomentose above; gills clay-coloured, ventricose, margin paler, waved, adnate, with a strong decurrent tooth; spores even; flesh white; taste at first pleasant. In one specimen the gills are just as figured by Persoon. Though he gives in his specific character *stipite nudo*, the stem is represented in the figure as scaly. In *A. furfuraceus* we find in the same group specimens with decurrent and others with adnate gills.

1654. *A.* (Inocybe) *cincinnatus*, Fr. Hym. Eur. p. 228.

Amongst moss. Coed Coch.

Spores granulated or irregular.

This appears to be what Quélet figures under the name of *A. dulcamarus*, his *A. cincinnatus* being rather referable to that species.

1655. *A.* (Inocybe) *carptus*, Fr. Hym. Eur. p. 230.

On the naked soil. Coed Coch.

Spores even.

In this very difficult subgenus it is of great consequence to ascertain the nature of the spores, which are sometimes quite even, at others granulated or irregular in outline, like those of so many of the *Hyporhodii*.

1656. *A.* (Inocybe) *Trinii*, Weinm. p. 194; Fr. Hym. Eur. p. 223.

Ballinluig, Rev. J. Stevenson.

Spores strongly granulated.

**A.* (Galera) *minutus*, Quélet, iii. p. 10, tab. 1. f. 5.

In woods amongst moss. Wrotham, Kent, Oct. 1, 1875.

1657. *A.* (Tubaria) *cupularis*, Bull. t. 554. f. 2; Fr. Hym. Eur. p. 272.

Ballinluig, Rev. J. Stevenson, no. 919.

**A.* (Crepidotus) *Rubi*, B.; Fr. Hym. Eur. p. 276.

Perthshire, Dr. Buchanan White.

1658. *A.* (Crepidotus) *Phillipsii*, B. & Br. Pumilus, umbrinellus; pileo obliquo striato glabro; stipite basi incurvo solido; lamellis angustis ventricosis, breviter adnatis.

On grass. Wrekin, W. Phillips, Esq.

Pileus about 3 lines across, stem 1–1½ line high, spores ·0002 long. A very distinct species.

1659. *A.* (Stropharia) *thraustus*, Kalkb. Fung. Hung. tab. 15. f. 4; Fr. Hym. Eur. p. 286, sub *A. squamoso.*

Rannock, Dr. Buchanan White.

1660. *A.* (Stropharia) *scobinaceus*, Fr. Hym. Eur. p. 288.

Glamis, Rev. J. Anderson. Two forms occur, one much more slender.

1661. *A.* (Psilocybe) *ammophilus*, Mont. & Dur. Exp. Sc. Alg. tab. 31.

On sand. St. Andrews, where it is abundant, Rev. M. Anderson. There is no doubt that it is a true *Psilocybe.*

Spores ·0005 long, ·00035 wide.

**A.* (Psathyra) *Gordoni*, B. & Br.; Fr. Hym. Eur. p. 308. *A. aulacinus*, Fr. Mon. ii. p. 348.

Abundant on the wood of a cold frame. Coed Coch, Oct. 31, 1876.

1662. *A.* (Panæolus) *sphinctrinus*, Fr. Hym. Eur. p. 311; Quélet, tab. 8. fig. 5.

Glamis, Rev. J. Stevenson.

The slender form figured by Quélet.

1663. *Cortinarius* (Telamonia) *quadricolor*, Fr. Hym. Eur. p. 378.

Coed Coch, Oct. 1876.

1664. *C.* (Hydrocybe) *dilutus*, Fr. Hym. Eur. p. 389.

Coed Coch, Oct. 1876.

1665. *C.* (Hydrocybe) *erythrinus*, Fr. Hym. Eur. p. 396.

In woods. Coed Coch, Oct. 1876.

1666. *Paxillus spilomæolus*, Fr. Hym. Eur. p. 402; Hoffm. Ic. tab. 10. fig. 1.

Stoke Poges, M. Terry, Esq.

The spotted pileus and dingy spores at once distinguish it from any *Tricholomata* with which it might be confounded.

The stem is sometimes incrassate at the base, sometimes quite equal.'

**P. leptopus*, Fr. Hym. Eur. p. 403.

King's Lynn, Mr. Plowright. Perthshire, Dr. Buchanan White.

1667. *Hygrophorus pulverulentus*, B. & Br. Parvus; pileo viscoso pulvinato candido; margine involuto tomentoso; stipite subæquali farcto, ima basi attenuato, toto roseo-pulverulento-punctato; lamellis crassis decurrentibus acie obtusis albidis.

Amongst pine-leaves. Glamis, Rev. J. Stevenson, no. 840.

Pileus about $\frac{1}{3}$ inch across, stem $\frac{3}{4}$ inch high, 1–2 lines thick. Allied to *H. eburneus*; but the rose-coloured meal with which the stem is covered separates it from all other species.

1668. *H. nemoreus*, Fr. Hym. Eur. p. 413 (not of Persoon).

Stoke Poges, M. Terry, Dec. 1876.

Spores white.

1669. *H. cinereus*, Fr. Ätl. Svamp. t. 30, in part.

Rannoch, Dr. Buchanan White.

1670. *H. subradiatus*, Fr. Hym. Eur. p. 416.

Glamis, Rev. J. Stevenson, no. 574. In pastures.

**H. turundus*, Fr. Hym. Eur. p. 418.

On peat soil. Farragon, Perthshire, at 1700 feet, Rev. J. Stevenson.

The typical form, which is brilliantly coloured. Fries makes our no. 1279 a variety under the name of *H. mollis*. This also occurs in Scotland.

1671. *H. glauco-nitens*, Fr. Hym. Eur. p. 421.

Pass of Killiecrankie, Rev. J. Stevenson. Marston Trussell.

Distinct from *H. nitratus*. Batsch's plant is probably *A. scaber*. It is certainly no *Hygrophorus*.

1672. *Lactarius victus*, Fr. Hym. Eur. p. 432.

In woods. Stoke Poges, M. Terry. Abundantly.

1673. *L. Terrei*, B. & Br. Cæspitosus; pileo corrugato depresso badio; stipite basi incrassato pileo concolori aurantiaco-tomentoso cavo; lamellis decurrentibus pallidis; odore glycino.

Stoke Poges, M. Terry, Nov. 6, 1876.

Pileus $\frac{1}{4}$ inch across; stem $\frac{3}{4}$–1 inch high, 2 lines thick. Allied to *L. subdulcis*.

1674. *Russula semicrema*, Fr. Ep. p. 350.

Glamis, Rev. J. Stevenson.

1675. *R. xerampelina*, Schæff.; Fr. Hym. Eur. p. 445.

Glamis, Rev. J. Stevenson.

One of the most distinct species of a very difficult genus.

1676. *R. consobrina*, Fr. Hym. Eur. p. 447.

Glamis, Rev. J. Stevenson.

1677. *Marasmius scorteus*, Fr. Hym. Eur. p. 468.

Perthshire, Aug. 1877, Dr. Buchanan White.

A more delicate and smaller species than *M. oreades*. Dr. White's plant approaches closely Batsch's fig. 109.

1678. *M. torquescens*, Quélet, tab. 23. f. 3; Fr. Hym. Eur. p. 471.

Amongst oak-leaves. Glamis, Rev. J. Stevenson.

The gills are finely serrulated. In the very young plant, when the pileus is conical, there is a slight indication of a veil.

1679. *M. languidus*, Fr. Hym. Eur. p. 473. *Agaricus grossulus*, Pers. Myc. Eur. t. 26. fig. 6.

On dead leaves. East Farleigh, Sept. 13, 1876.

Just intermediate between the normal form and the short-stemmed variety figured by Persoon.

Stems pallid; gills strongly decurrent.

1680. *Panus patellaris*, Fr. Ep. p. 400.

On cherry. Forres, the Rev. J. Keith.

1681. *Merulius læticolor*, B. & Br. Totus effusus adnatus læte aurantiacus; margine tomentoso albo; hymenio e lævi plicato-rugoso; plicis distantibus.

On sawdust and leaves. King's Lynn, Mr. Plowright.

We had at first referred this plant to *M. aureus*; but an authentic specimen of that species shows that our fungus is very different and brighter in colour than any other species.

1682. *Polyporus leucomelas*, Fr. Syst. Myc. i. p. 346.

Aviemore, Rev. J. Keith.

A curious esculent species, which attains a considerable size.

Pileus and stem here and there changing to black; flesh soft, marbled, pinkish when exposed to the air; pores white, but soon changing colour, unequal, slightly sinuated, shortly decurrent. Taste pleasant, but slightly astringent. There are two distinct forms figured by Micheli—the one with a short obtuse stem, the other with the stem more equal.

We have authentic specimens of both—of the former from Herr Trog, of the latter from Fries. Mr. Keith's plant belongs to the former state. The fungus was eaten by some small animal, possibly a squirrel.

**Porothelium Friesii*, Mont. in Ann. d. Sc. Nat. 1836; Fr. Hym. Eur. p. 595.

Wothorpe, Oct. 7, 1840.

In studying the genus we find three distinct species which we confounded with *P. Friesii*, from which they differ greatly.

1683. *P. Stevensoni*, B. & Br. Contextu crassiusculo

gelatinoso; margine substuppeo deglubente; hymenii verrucis distinctis, interstitiis glaberrimis; globulo apicali diaphano limpido luteo.

Glamis, May 1877, Rev. J. Stevenson.

1684. *P. Keithii*, B. & Br. Arcte adnatum umbrinellum; ambitu tenuissimo primum subgelatinoso; verrucis brevibus demum collapsis, centro gelatinosis.

Forres, Rev. J. Keith.

1685. *P. confusum*, B. & Br. Arcte adnatum pallidum; margine tenuissimo arachnoideo; contextu primum floccoso-pulverulento; verrucis minoribus.

Glen Tanner, Aberdeenshire. Leigh Wood, C. E. Broome.

1686. *Hydnum* (Resupinatum) *limonicolor*, B. & Br. Adnatum læte citrinum; aculeis confertis acutis brevibus; mycelio candido parco l. obsoleto.

On stone buried amongst pine-leaves. Glamis.

The mycelium when present is distributed amongst the decayed pine-leaves.

1687. *H.* (Resupinatum) *multiforme*, B. & Br. Ochroleucum primitus læve corticiiforme, demum hic illic fertile; aculeis congestis acutissimis, deinde pallidis fimbriatis; contextu floccoso-farinaceo.

Glamis, Menmuir.

Very variable, sometimes almost towy, with the margin inflexed.

1688. *H. sordidum*, Weinm. p. 370; Fr. Hym. Eur. p. 614.

Stoke Poges, M. Terry, Nov. 1876.

1689. *H. nodulosum*, Fr. Hym. Eur. p. 616.

On fir-stumps. Glamis, Rev. J. Stevenson.

1690. *Grandinia crustosa*, Fr., var. *lignorum*, Hym. Eur. p. 627.

On fir. Glamis, Rev. J. Stevenson.

1691. *G. mucida*, Fr. Hym. Eur. p. 626.

Glamis, Rev. J. Stevenson, no. 867.

1692. *Cladoderris minima*, B. & Br. Alba; e basi stipitiformi vel obsoleta oriunda, resupinata; pileo tomentoso; hymenio e costis ramosis radiato.

On birch. Glamis, Rev. J. Stevenson, no. 849.

Flabelliform, from two to three lines across. Though small, it has exactly the structure of the exotic species.

* *Thelephora tuberosa*, Grev. t. 178.

Amongst grass and moss. Perthshire, Dr. Buchanan White, Aug. 1877.

We were delighted to receive this interesting species, which does not seem to have occurred since the figure of

Greville was published. The specimens are not quite so tuberous, nor, in general, the branches quite so much flattened as he represents them; but, from the analogy of allied North-American species, there is no doubt about the identity.

1693. *T. crassa*, Lév. Ann. d. Sc. Nat. 1844, ii. p. 209; Bonite, tab. 139. fig. 1.

Berkshire, Sawyer.

Having no type, it is impossible to say positively that it is Léveillé's plant, though the description and figure agree. Widely diffused over soil partially covered with moss, and forming irregular, thick, rounded, umber-brown masses of a velvety aspect but not setulose.

1694. *Corticium cinnamomeum*, Fr. Ep. p. 561.

On birch. Glamis, Rev. J. Stevenson.

1695. *C. citrinum*, Pers. Myc. Eur. p. 136.

On thorn. Perthshire, Dr. Buchanan White.

1696. *C. violaceo-lividum*, Fr. Hym. Eur. p. 655.

On dead wood. Glamis, Rev. J. Stevenson.

1697. *C. limitatum*, Mont. Ann. d. Sc. Nat. 1836; Fr. Ep. p. 565.

On *Cytisus*. Perth, Dr. Buchanan White.

We have no type; but though the extreme ciliated margin is in most places white, the dark zones and dull nodular hymenium are characteristic.

* *C. serum*, Pers.; Fr. Hym. Eur. p. 659.

Some specimens come very close to some states of *Kneiffia setigera*, Fr., to which it is allied. See Hym. Eur. p. 629.

1698. *Cyphella stuppea*, B. & Br. Erumpens, sessilis, pezizæformis, externe stuppea, ex brunneolo albescens; hymenio fusco.

Bursting through the tender cuticle of broom. Rev. M. Anderson, March 1873.

* *Clavaria fusiformis*, Sow. t. 234.

Ballinluig, at 2000 feet. Rev. J. Stevenson.

1699. *Typhula gracillima*, White. Alba, stipite gracillimo curvo glabro; clavula elongata.

On various herbaceous plants. Perthshire, Dr. Buchanan White.

1700. *Dacrymyces vermiformis*, B. & Br. Minuta grisea vermiformis; sporophoris globosis; sporis globosis pallide fuscis.

On rotten wood. Bathford plantations, C. E. Broome, April 1, 1877, also April 28, 1876.

Sporophores ·0005 inch in diameter; spores ·0002.

Plate III. fig. 1. *a*, plant *in situ*, magnified; *b*, sporophores with spores, highly magnified.

**Tilmadoche mutabilis*, Rtfki. *Physarum nutans*, Pers.

This is very properly separated by Rostafinski from *Physarum*, in which genus it was always a "vexata quæstio."

1701. *Ostracoderma pulvinatum*, Fr. Syst. Myc. iii. p. 214. Sibbertoft, 1873. On an old sack which had been lying on a dunghill.

Looks at first sight like a white *Diderma* (*Chondrioderma*, Rtfki.), but not gelatinous in a young state.

Spores ·0003 inch long.

1702. *Glœosporium Hendersoni*, B. & Br. Hypophyllum, sparsum; gelatina placentiformi; sporis oblongis; nucleo colorato.

On orange-leaves in a conservatory. Milton, Mr. J. Henderson.

Spores ·0005–·0006 inch long.

1703. *G. violæ*, B. & Br. Maculis pallidis demum albis; pustulis paucissimis vel solitariis, sporis aurantiacis in matricem effusis.

On leaves of violet. Glamis, Rev. J. Stevenson, no. 893.

The effused spores, especially when developed on large white spots, make it a very striking species.

1704. *Bactridium acutum*, B. & White. Candidum, parasiticum; floccis deorsum attenuatis, apice acutis 1–3-septatis; articulo penultimo tumido. Sc. Nat. iv. p. 162, tab. 2. fig. 4.

On hymenium of *Peziza cochleata*. Perthshire, Dr. Buchanan White.

Distinguished from *Bactridium helvellæ* by its constantly very acute apex and attenuated base. A specimen from the same locality sent by Mr. Stevenson had not the same parasite.

PLATE III. fig. 2. Threads, magnified.

1705. *Cylindrosporium longipes*, Preuss, in Sturm, Fl. iii. 29, tab. 35.

On the shell of a walnut. Perthshire, Dr. Buchanan White.

The base of the stem, as in Preuss's figure, is dark, the upper part hyaline and breaking up into cylindrical spores, absolutely truncate at either extremity. This is probably *Chalara fusidioides*, Sacc. Corda's plant seems different, being white throughout.

1706. *Trichobasis Lynchii*, B. in Gard. Chron. Aug. 25, 1877. Maculis parvis pallidis; sporis sparsis raro confluentibus; pseudosporis flavis obovatis pulcherrime echinulatis; stipite brevi.

On a *Spiranthes* from Trinidad. Kew, Mr. R. Irwyn Lynch.

Generically distinct from *Uredo confluens*, var. *orchidis*, and different in habit. *U. gynandræarum*, Cda. iii. tab. 1. fig. 9, agrees in habit; but the spores are dark, and the pustules bullate.

1707. *Ustilago Kuehniana*, Wolff; Fisch. de Wald. Ust. p. 29; Gard. Chron. July 1876.

On *Rumex acetosella* from permanent meadow-land in Mr. Lawes's Park at Rothhamstead, Dr. Gilbert.

Spores ·00045 inch long.

1708. *Protomyces Comari*, B. & White. Pustulis fuscis; sporis in cellulis tumidis matricis ternis vel solitariis.

On *Comarum palustre.* Aug. 1877, Loch of Kinordy, Forfarshire, Rev. M. Anderson.

Resembling at first sight *Isothea pustula*, but a true *Protomyces.*

The pustules are far more prominent than in *P. menyanthis.* Spores ·001–·0012 inch long, broadly obovate.

MILESIA, White, nov. gen. Peridium incarceratum reticulatum, basi inter cellulas matricis radicans; sporæ obovatæ echinulatæ per ostiolum minutum demum emissæ.

1709. *M. polygoni*, B. & White. Sc. Nat. *l. c.* tab. 2. f. 5.

On the underside of leaves of *Polygonum viviparum.* Glen Tilt, Dr. Buchanan White.

Evidently allied to *Endophyllum*, but distinguished by its reticulated thoroughly incarcerated peridium, which does not burst irregularly, but discharges its spores by a minute pore. The spores closely resemble those of *Uredo pteridum*, White, ·0012–·0017 inch long. Sc. Nat. *l. c.* tab. 2. f. 6.

PLATE III. fig. 3. *a*, pseudoperidium with its hyphæ; *b*, ditto, crushed; *c*, single spore. All more or less magnified.

1710. *Isaria sphingum*, Schwein. Car. no. 1298; Fr. Syst. Myc. iii. p. 275.

On pupæ of Diptera. Kincardineshire, Mr. Taylor.

Mycelium much branched.

1711. *I. tomentella*, Fr. Syst. *l. c.* p. 276.

On beech-leaves and mast. Creeping over the leaves, and at length sending up clavate fertile heads.

Colour just that of *Arcyria nutans.*

1712. *Stysanus putredinis*, Cda. iii. tab. 2. fig. 36.

On decayed leaves. Glamis, Rev. J. Stevenson, no. 873.

Spores ·00025–·00035 inch long.

1713. *Stilbum Stevensoni*, B. & Br. Sparsum; stipite

brevissimo nigro; capitulo niveo globoso; sporis minutissimis globosis.

Glamis, Rev. J. Stevenson. Scattered on dead wood, on which it looks like a very minute *Didymium*.

Spores too small to admit of measurement.

1714. *S. orbiculare*, B. & Br. Album; plantulis sparsis gregariis e macula alba pulverulenta oriundis; stipite cylindrico tomentoso apice quandoque velo lacerato ornato; capitulo globoso; sporis oblongis minutis.

On *Lindbladia effusa*. Aviemore, Rev. J. Keith. Forming patches an inch or more in diameter; springing from a white, thin, pulverulent stratum, which is at length stained by the *Lindbladia*.

Spores ·0002 inch long.

At first sight it looks like a parasitic *Hydnum*.

Plate III. fig. 4. *a*, plant, nat. size; *b*, a portion, magnified; *c*, spores of *Lindbladia*; *d*, spores of *Stilbum*, magnified.

**Ægerita candida*, P. Syn. p. 684.

A fawn-coloured form was found at New Pitsligo by the Rev. J. Fergusson and at Killin by the Rev. M. Anderson. A form also occurred at Glamis on herbaceous stems, Stevenson, no. 156. *Crocysporium torulosum*, Bonorden, tab. iv. fig. 90, is evidently the same thing.

**Peronospora violacea*, B. Outl. p. 349.

On petals of *Knautia arvensis*. As some doubt has been expressed about this species, which was found June 30, 1859, it has been thought advisable to give a figure.

Plate III. fig. 5. Flocci with spores *in situ*, magnified.

**P. calotheca*, De B. Ann. d. Sc. Nat. 1863, p. 111.

On *Asperula odorata*. Rev. J. Fergusson.

1715. *P. affinis*, Rossman, in Rab. Herb. Myc. ii. no. 489.

On *Fumaria*. King's Cliff. Distorting the plant.

1716. *Dactylium cervinum*, B. & Br. Effusum, pallide cervinum; floccis ramosis articulatis; sporis obovatis uniseptatis deorsum apiculatis.

On *Cytisus laburnum*. Ballinluig, Rev. J. Stevenson, no. 989. Lambley, Notts.

1717. *D. spirale*, White. Candidum e macula tosta oriundum, floccis spiralibus simplicibus; sporis magnis uniseptatis medio constrictis, utrinque obtusissimis. Sc. Nat. *l. c.* p. 161, tab. 2. f. 3.

On the underside of leaves of *Polygonum viviparum*. Glen Tilt, Dr. Buchanan White. Forming little white patches

consisting of scattered simple spiral flocci ·004 inch high. Sc. Nat. *l. c.* p. 162, tab. 2. f. 2.

Spores ·0009–·0012 inch long, half as wide.

PLATE IV. fig. 6. *a*, *plant on leaf, slightly magnified*; *b*, *threads*; *c*, *spores, young and mature, highly magnified.*

1718. *D. modestum*, White. Candidum e macula tosta oriundum; floccis simplicibus subrectis vel leviter flexuosis; sporis magnis uniseptatis elongatis medio constrictis.

On leaves of *Alchemilla alpina*. Glen Tilt, Dr. Buchanan White.

Closely allied to *D. spirale*, but distinguished not only by the flexuous threads, but the very different spores, which are ·001 inch long, one fourth as much wide.

PLATE IV. fig. 7. *a*, *threads*; *b*, *spores, highly magnified.*

1719. *Mucor stolonifer*, Ehrb. Sylv. Myc. *Rhizopus nigricans*, Mycetog. tab. xi. 1–7.

On melon. Glamis, Rev. J. Stevenson, no. 712.

1720. *Desmazierella acicola*, Lib. Ann. d. Sc. Nat. 1829, xvii. p. 83, tab. 6. f. 1, 3. Phillips, exsiccata.

Near Shrewsbury, W. Phillips, Esq.

1721. *Helvella atra*, Kön.; Fr. Syst. Myc. ii. p. 19.

Loch Laggan, Dr. Buchanan White.

**Peziza* (Geopyxis) *Percevali*, B. & Cooke, Myc. fig. 192. *P. ciborium* major, Fr. no. 1479.

**P.* (Geopyxis) *ammophila*, Dur. & Lév.; Cooke, Myc. fig. 100. *P. arenaria*, no. 1619.

Dr. Cooke has very properly pointed out that the St.-Andrèw's plant is identical with that from Algeria.

1722. *P.* (Sarcoscyphæ) *coprinaria*, Cooke, Myc. fig. 149.

On cow-dung. Batheaston, March 1877.

1723. *P.* (Hymenoscyphæ) *Candolleana*, Lév. Ann. d. Sc. Nat. 1843, xx. p. 232, tab. 7. fig. 4.

Batheaston, C. E. Broome, raised under bell glass from

1724. *P.* (Calycinæ) *albida*, Roberge; Desm. Exs. no. 2004.

On ash-petioles. East Farleigh, Sept. 13, 1876.

1725. *Diatrype coramblycola*, B. & Br. Pustulis elongatis bullatis; ostiolis prominulis asperatis; sporidiis fusiformibus 3–4-nucleatis.

On cabbage-stalks. Forres, Rev. J. Keith, Apr. 17, 1875.

Sporidia ·00035 long. Probably not an uncommon species.

· 1726. *Eutypa aspera*, Fr. sub *S. eutypa*, b, Syst. Myc. ii. p. 478.

On wood. Glamis, Rev. J. Stevenson, no. 880.

1727. *Sphæria maculans*, Desm. Exs. no. 1784.

On stalks of dead *Brassicæ*. Perth, Dr. Buchanan White. Sporidia yellow, ·0014–·002 long, multiseptate.

1728. *S. Stevensoni*, B. & Br. Peritheciis sparsis hic illic congestis ovatis sursum attenuatis; ascis gracilibus; sporidiis uniseriatis, anguste ellipticis, 2–3-nucleatis.

On dead wood. Glamis, Rev. J. Stevenson, no. 869.

Sporidia ·0002 inch long.

**Chætosphæria innumera*, Tul. Sel. Fung. Carp. ii. p. 253, tab. xxxiii. *S. innumera*, B. & Br. Out. p. 395.

On dead wood. Rev. J. Stevenson. Glamis, no. 870.

Sporidia ·0003–·00035 inch long.

1729. *Cephalotheca sulfurea*, Fuckel, Fung. Rhen. no 2313. Peritheciis sparsis gregariis, globosis, villo sulfureo tectis, demum vertice glabris atrisque, denique totis glabris et mox diffractis; sporidiis ovatis, hyphis ascigeris multiguttulatis.

On a rotten board in Mr. Spencer Perceval's grape-house, Clifton, April 1876.

Plate IV. fig. 8. *a*, plant *in situ*, magnified; *b*, dark rigid hairs and various threads; *c*, structure of the perithecium; *d*, sporangia; *e*, sporidia; *f*, young perithecium produced within the old one.

The specific character given above is copied from Fuckel. The sporangia produced within the perithecia on the hypha are something quite different from anything which occurs in *Sphæriacei*; and perhaps it is better to consider them as asci, though even then their mode of development is abnormal. Not less curious is the product of a new perithecium within the old one. The structure, too, of the perithecium is very singular.

**Dothidea betulina*, Fr. Syst ii. p. 554.

Glamis, Rev. J. Stevenson, July 6, 1874.

Stylospores uniseptate, ·001 inch long.

**Phacidium Vaccinii*, Fr. Syst. ii. p. 575.

Stylosporous state forming little crowded dark specks, containing *Bacteria*-like bodies, ·00016 inch long.

1730. *Ascochyta metulæspora*, B. & Br. Maculis orbicularibus fuscis, peritheciis minutis pallidis, sporis metulæformibus.

On leaves of ash. Ballinluig, Rev. J. Stevenson, no. 908.

The shape of the spores is singular, like that of the pieces of wood with which boys play called tipcats (*bâtonnets* Gall.).

III.—*Notes on Sessile-eyed Crustaceans, with Description of a new Species.* By the Rev. THOMAS R. R. STEBBING.

[Plate V.]

Caprella fretensis, n. sp. (Pl. V. fig. 1.)

The head of this species has a small rostrum, acute in appearance when viewed laterally, but obtuse when seen from above. The eyes are small, ovate, slightly protuberant within the narrow bounds of the head, which is distinguished from the first pereion-segment only by a minute groove above, the sides being continuous and converging backwards to the junction of the first with the second segment; the latter is long and narrow, widest near its termination, where it receives the insertion of the second gnathopods. The third, fourth, and fifth segments are considerably shorter than the second; in one specimen they are also decidedly shorter than the combined head and first segment, but in another specimen they are nearly equal to them; the third and fourth segments are widest at the branchial vesicles, the fifth at the end where the legs are attached; the sixth segment is the widest of all, but only about half the length of the fifth; the seventh is no longer than the sixth, and much narrower. The pleon is half concealed by the hinder margin of the last pereion-segment; it occupies about a third of the width of that margin, beyond which can be seen a pair of minute style-like processes or one-jointed pleopoda, and between these a more conspicuous pair with short convergent peduncles and divergent oval rami.

The upper antennæ have the first joint longer than the head, and stout by comparison with that somewhat insignificant organ. The second joint is much longer, the third somewhat shorter than the first; the second is a little, and the third a good deal furred on the under margin, chiefly towards the distal end. The flagellum, of fourteen articulations pretty uniform in length, tapers gradually to a point; almost all the articulations carry two "olfactory" filaments. The lower antennæ do not reach to the end of the second joint of the peduncle of the upper. The first portion that projects distinctly from the head is a very short joint; to this succeeds one twice its length, but still short. The next is nearly double these two combined, more slender, curved, and ornamented with two rows of cilia beneath. The next portion is still longer and has longer fringes. The piece that succeeds to this is of equal length but diminished breadth and shorter fringes. Lastly follows a short, narrow, unfringed piece,

tipped with two or three short, hooked, compound setæ. The cilia of the fringes just mentioned appear to be finely plumose. The first gnathopods are inserted just below the eyes; so that the dorsal groove-line, which marks the termination of the head, is well to the rear of them. Of these limbs the basos is narrow, scarcely so long as the hand; the two following joints are short and insignificant; the wrist is also short, but broad and cup-shaped. The hand is well developed, longer than broad, swollen out, except at its junction with the finger; here and along both edges it has a good crop of bristles. Its ventral surface also shows some very short stiff-looking down, and near the base two stout divergent spines, between which the finger closes down. The finger itself is broad, as long as the hand; its outer edge curved, its inner edge nearly straight, serrated with blunt serrations. The whole gnathopod is very small. Not so the second pair, although in these the thigh is scarcely longer than the breadth of the second segment. The wrist also is a small rectangular piece, almost square; but the hand is of great size, nearly as long as the segment to which the limb is attached. The narrowest part of this elongate hand is at the base; the anterior margin is nearly straight. The hinder margin is broken a little beyond the middle by a triangular process surmounted by a small spine; beyond this process the margin runs on with some slight sinuosity to its angular termination, where it turns to meet the finger-joint. The massive finger is set on at right angles to the anterior margin; and when it is closed the great swelling curve of its outer edge is brought round into the recess formed by the process above mentioned; while, under the same circumstances, the convex portion of its inner curve is overlapped by the distal angle of the hand. The portion of the hand between the distal angle and the triangular process is furred with long hairs. The branchial vesicles are narrowly ovate. The fifth, sixth, and seventh pairs of legs scarcely differ in any respect except size, the sixth being larger than the fifth, and the seventh than the sixth. In the seventh the thigh is nearly as long as the segment to which it is attached; the following joint is quite small; the triangular metacarpus is about the same size as the thigh, and carries a small group of setæ on the distal exterior angle; the wrist is shorter, somewhat squared in shape, but broadest distally; it has pairs of short setæ or spines along the inner edge: the hand is twice the length of the wrist; it has a concave palm commencing at a third of its length from the wrist, with two broad, blunt, serrated spines at its origin, and four pairs of spines along its edge, which, when highly magnified, seem

to be more or less finely pectinate, with whip-like ends. The back of the hand carries three or four groups of setæ. The finger is strong and curved, and matches the palm in length.

This species bears a strong general resemblance to *Caprella æquilibra*, as described by Messrs. Bate and Westwood; but, whereas in that species "the head is round and unarmed," here the head has a small rostrum; in that the second pereion-segment "is armed inferiorly, in the ventral median line, with a long straight tooth," of which there is no trace in the present species. In *Caprella æquilibra* the hands of the second gnathopods have the palms two thirds of their length, instead of less than half, and are figured with the greatest width near the base, while in our species the hands, contrary to what is usual among the Caprellidæ, widen distally. The third, fourth, and fifth segments are not unusually short as in *C. æquilibra*.

The two specimens which have supplied the above details were dredged at Salcombe in August 1875, in the estuary, whence the specific name.

The pair of spines at the palm of the hinder legs seem to be correlated in an interesting manner with the generic distinctions which have been established by various authors in the family of the Caprellidæ. Thus, in both the known forms of *Proto* they are placed at the origin of the palm, are rather slender, with the inner margin very finely pectinate, and terminate in a strong, though slightly curved, double hook. In *Protella* of Dana and Spence Bate, = *Ægina* of Kröyer and A. Boeck, the species *P. phasma* has them at the base of the palm as in *Proto*, but short and simple, except for one minute notch not far from the apex. In *Caprella acanthifera* of Bate and Westwood, the *Æginella spinosa* of A. Boeck, they are long and slender, situated more than halfway down the inner margin of the hand, and have the distal portion of their own inner margin finely serrate. They are both preceded and followed by other pairs of finely pectinate spines with whip-like ends. In the accepted species of *Caprella*, as far as I have had an opportunity of examining them, namely in the forms known as *C. linearis*, *C. lobata*, *C. tuberculata*, *C. acutifrons*, as well as in the new species just described, the pair of spines under discussion agree in position at the origin of the palm, and are alike in being more or less boldly serrate on the inner margin, while they exhibit slight specific differences in regard to comparative length, breadth, and bluntness. Finally *Caprella typica* of Spence Bate, = *Podalirius typicus* of Kröyer and of A. Boeck, is

described as having the joints of the hinder legs slender, naked, and destitute of spines. A specimen in my possession, of *C. lobata*, has on one side of one of its hands an extra spine, illustrating the possibility of variation in an animal not under domestication.

Stimpsonia chelifera, Spence Bate. (Pl. V. figs. 2 & 3.)

This species has been already figured and pretty fully described by Mr. Spence Bate in his Museum Catalogue, and by Messrs. Bate and Westwood in their well-known work. Nevertheless the examination of several specimens taken on the shores of Torbay has brought to light some peculiarities that seem well worthy of notice.

The secondary flagellum of the upper antennæ is not uniarticulate, but two-jointed, the second articulation being rather the longer, and the two together slightly exceeding in length the first articulation of the principal flagellum. In the lower antennæ there is a character which appears to develop itself only in the adult male. The long penultimate joint of the peduncle is at the base as deep as the thick deep joint which precedes it; this dilatation is slight on the upper margin, where it affects the whole thickness of the joint, but is considerable on the lower margin, where it takes the form of a large flattened lobe. The preceding joint has its distal margin more or less deeply indented in all specimens, as if prepared to give a suitable holdfast to its dilated successor; but from the variety of the dilatations themselves it may be inferred that they are only acquired in very advanced age.

In the first gnathopods the long infero-distal process of the wrist varies greatly in length, sometimes not reaching nearly to the extremity of the hand. In the space between this process and the hand, but nearer to the latter than the former, there is a small tooth, with long setæ springing from both sides of it. Three or four transverse rows of setæ line the lower margin of the wrist. The inner margin of the hand does not follow the uniform curve of the outer margin, but, beginning with a concavity, bulges centrally; it has three rows of setæ. There are three other groups on the inner face of the hand, and two groups on the outer margin, one centrally, the other distally placed. The coxæ of these gnathopods have the infero-anterior angle produced under part of the lower margin of the head.

The second gnathopods have a small process at the anterior distal angle of the basos. The almost rectangular metacarpus has its distal margin fringed with setæ of various lengths, without regularity in the line of insertion; along its lower

margin the elongated wrist is adorned with several transverse rows of adpressed setæ. There is one row away from the margin near to the junction of hand and wrist. The lower margin of the hand exhibits similar rows of setæ; the waved palm is set with cilia on both sides. In respect of this second pair of hands the Torbay specimens, with more or less variation among themselves, differ all of them from that described by Mr. Spence Bate from Salcombe. The thumb-like process curves in towards the finger instead of out and away from it; its inner edge is perfectly simple, without any of the semispiral grooving figured by the author just mentioned; it has a quite blunt or truncate extremity, within which is inserted a strong, bent (or in some cases straight), movable spine. The length of the thumb seems to depend on the age of the animal, that specimen in which it is longest having other marks of advanced life upon it: thus, the wrist-process of the first gnathopods is very long, the finger-points of the second gnathopods are worn, and the penultimate joint of the lower antennæ has the large dilatations before described. A specimen in my collection, unobservantly assigned to *Aora gracilis* till its true character was detected by the Rev. A. M. Norman, has an interesting peculiarity in this second pair of gnathopods. One is of the usual form; but the other has the palm nearly straight, not waved, without any thumb or terminal hinged spine. This is an approach to the character of the female. The gnathopods of the female differ very considerably from those of the male. The two pairs are very similar in general construction; but the first are much the larger. In both, the hands are subequal to the wrists or a little larger. The hands and wrists are fringed on the lower margin as in the male. Both these joints are broad, and about twice as long as they are broad. There is no process to the wrist, or thumb to the hand, but at the lower extremity of the palm a movable spine in both pairs of gnathopods. The finger is internally serrate in each; and that of the first gnathopods considerably overlaps the palm.

There is on the whole a close resemblance between the female of this species, the female of *Aora gracilis*, and the female of *Microdeuteropus anomalus* as figured and described by Messrs. Bate and Westwood.

The pereiopoda are alike in both sexes. The first two pairs have the metacarpus and wrist much broader than the hand; the hand narrows distally. In the three following pairs, of which the last is considerably the longest, the wrist is shorter than either metacarpus or hand. At the extremity of the hand there is a long bunch of cilia. The telson, seen

from above, has the hinder margin rounded in the middle, but produced to an angle on each side of the convexity, neither of these divisions being produced beyond the other. On each of the angular portions there is an upright hair. The peduncles of the last uropods are short and thick, with three little close-set spines distally; they extend but a little way beyond the telson. Each peduncle carries a pair of equal branches scarcely longer than itself.

Cyclura venosa.

I take this opportunity of noticing that *Cyclura venosa* from Australia, described in the Linnean Society's Journal, Zoology, vol. xii. p. 146, pl. vi., should be called *Cycloidura venosa*, the original name having been given in ignorance of its previous appropriation in another domain of zoology.

Arcturus linearis.

This species has been figured and described in the 'Transactions of the Devonshire Association' for 1874, but there wrongly named *Arcturus gracilis*, whereas it is a perfectly distinct new species. The specific name now chosen refers to the close resemblance between this product of the Devonshire waters and the *Arcturus lineatus* from Algoa Bay, South Africa, described in this Magazine, August 1873.

Callimerus acudigitata.

This species was described in this Magazine in December 1876, both genus and species being new. It has been suggested to me that the generic characters ought to be separately stated; they are as follows:—Antennæ subequal; superior antennæ without secondary appendage; first pair of gnathopods simple; second pair having the carpus infero-anteriorly produced, the coxæ of the second pair covering those of the first. Penultimate pleopoda shorter than either of the other pairs. Telson simple.

EXPLANATION OF PLATE V.

Fig. 1. *Caprella fretensis*, n. sp. 1 *a*. Natural size in linear measurement. 1 *b*. Side view of head. 1 *c*. Pleon, seen from above. 1 *d*. Last segment of the pereion with the pleon, seen from below. 1 *e*. Ventral view of the pleon, more highly magnified. 1 *f*. Terminal portion of upper antenna. 1 *g*. Lower antenna. 1 *h*. Terminal portion, more highly magnified. 1 *i*. Maxilliped, seen from below. 1 *j*. First gnathopod. 1 *k*. Inner face of the same, more enlarged. 1 *l*. Second gnathopod. 1 *m*. Fifth leg. 1 *n*. Seventh leg. 1 *o*. Portion of palm of ditto, showing the

pair of serrate spines. 1 *p*. One of the serrate spines, highly magnified.

Fig. 2. *Stimpsonia chelifera*, Spence Bate. 2 *a*. Portion of upper antenna, showing secondary flagellum. 2 *b*. Mandible. 2 *c*. Maxilla. 2 *d*. Maxilliped. 2 *e*. Second gnathopod.

Fig. 3. Tail-piece of *Stimpsonia chelifera* (another specimen), seen from above. 3 *a*. One of the first gnathopods. 3 *b*. One of the second gnathopods. 3 *c*. The other of the second gnathopods.

IV.—*On the Young of* Pityriasis gymnocephala. By Dr. F. Brüggemann.

The sexes of this remarkable Bornean bird are known to differ in the colour of their plumage, the female showing some red spots on the abdomen. A *young* female, sent by Dr. George Fischer from Moeara Teweh, interior of S.E. Borneo, shows several peculiarities, which I think worth drawing attention to. Comparing it with the adult male, a specimen of which was also procured in the same locality by Dr. Fischer, the signs of its immaturity are found in the smaller terminal hook of the upper mandible, in the absence of horny tips to the feathers of the hind neck, in the lower stage of development of the rigid feathers on the fore neck, in the pale horn-colour of the feet and nails (the adult having the former yellowish and the latter blackish), and in the sooty-black (not deep-glossy-black) plumage. The narrow velvety edgings of the black feathers are also less pronounced; and the red colour in the plumage is a shade lighter than in the adult, rather scarlet than crimson.

All this is, of course, nothing curious; but the following characters were scarcely to be expected:—The crown of the head is entirely *bare*, without any trace of the papillæ with which it is crowdedly covered in the adult; of the large tuft of rigid brownish grey feathers in the auricular region there is no indication, the feathers on this spot being of *normal* structure and *red*, like the rest of the head-feathers; breast, belly, and flanks are scarlet-red, somewhat mixed, in an irregular way, with black, the basal part of the feathers, or the whole feather, excepting a broad border, being generally blackish; it may be observed that the red edgings, which are much decomposed, are gradually worn off. The red colour decreases in extent on the abdomen, where it is confined to the tips of the feathers. There are also traces of red edgings on the scapularies and wing-coverts. The thigh-feathers (which are of a uniform red in the adult) are black, mixed only in the upper part of the thigh with some red ones.

Thus the young bird exhibits a far greater amount of vivid red colour than the adult, and, besides, a different mode of distribution: it has the under surface of the body for the greater part *red* and the thighs *black*, whereas in the mature bird the under surface is *black* and the thighs *red*. This is, at all events, a noteworthy fact; yet it is not quite exceptional among birds.

In the young of *Tanygnathus luzonensis* the head is *green* like the greater part of the plumage, and the rump is light *blue*; in the adult the upper part of the head is light *blue* and the rump *green* (Brüggemann, Abh. Ver. Brem. v. p. 38).

The immature *Lorius histrio* has the whole crown of the head *blue* and the fore back *crimson*; the old bird has the head almost entirely *crimson* and the back *blue* (Brügg. *l. c.* p. 41).

In *Nectarinia flavostriata* the wings and tail of the young bird (the general plumage of which is olive-coloured) are *red*; those of the adult are blackish brown, and the remainder of its plumage is *red* (Brügg. *l. c.* p. 74).

To add an example of a common indigenous bird, we find that in the young bird of the spotted woodpecker (*Picus major*) the crown of the head is crimson, and the upper surface of the body partly marked with white, where the adult is of a uniform black.

These extraordinary instances of the young birds showing *ornamental* colours in parts of the body which are plain-coloured in the adults can only be explained by the suggestion that the immature plumage gives a recapitulation of the colours possessed by the ancestors of the species. Thus the young *Picus major* shows a stronger resemblance to the other European species (*P. leuconotus*, *P. Lilfordii*, *P. medius*) than the adult does; or, in other words, it has kept more strictly the colours of the common parent of the group.

I am of opinion that many more instances of such conservative *ornamental* plumages in the young birds can be found if they are searched for.

V.—*Characters of new Genera and of some undescribed Species of Phytophagous Beetles.* By Joseph S. Baly, F.L.S.

[Continued from ser. 4. vol. xx. p. 386.]

Fam. Chrysomelidæ.

Chrysomela Jacobyi.

C. oblongo-ovata, convexa, nigra, nitida, capite thoraceque minute

punctatis, hujus lateribus incrassatis, intus sulco foveolato marginatis; elytris sat fortiter substriatim punctatis, limbo exteriore late rufo.

Long. 3½–4 lin.

Hab. China, Province of Shantung.

Antennæ half the length of the body. Thorax twice as broad as long; sides nearly straight and parallel from the base to the middle, thence rounded and converging to the apex, anterior angles acute; upper surface transversely convex, minutely punctured, rather more coarsely punctured along the basal margin; lateral margin thickened, impressed with a few deep punctures; the margin is bounded within by a deep, very coarsely and irregularly punctured groove, the middle portion of which is less deeply excavated than the rest of its surface. Elytra rather broader than the thorax, broadly oblong, rather strongly punctured, the punctures arranged in irregular longitudinal rows; on each elyton are several smooth impunctate vittæ.

Phyllocharis eximia.

***P.* elongata, modice convexa, nitida, subtus rufo-testacea, pectoris medio, pleuris, abdominis basi pedibusque læte cyaneis; supra læte cyanea, verticis macula thoracisque lateribus latis rufo-testaceis; elytris tenuiter punctatis, punctis prope suturam striatim dispositis, apicem versus fere deletis, singulatim macula humerali, fascia transversa prope medium, intus abbreviata, margine exteriore inter maculam et fasciam, vittisque duabus, una curvata, a basi ad elytri tertiam partem extensa, alteraque recta, apicali rufo-testaceis.**

Long. 5–5½ lin.

Hab. Australia, Rockhampton.

Antennæ robust, second joint moniliform, third one half larger than the second, fourth and the following two equal, each rather longer than the second. Thorax twice as broad as long; sides straight and parallel, obsoletely sinuate behind the middle, rounded and converging at the apex; disk smooth, impunctate, impressed on either side with a distinct fovea; basal margin distinctly punctured. Elytra oblong, sides parallel, converging near the apex, the latter acutely rounded.

Phyllocharis Jansoni.

***P.* elongata, modice convexa, rufo-testacea, nitida, pleuris, abdominis basi, pedibus antennisque obscure metallice cærulcis, his extrorsum nigris; capitis macula thoracisque maculis duabus, his transversim positis, fuscis; elytris oblongis, tenuiter substriatim punctatis, punctis apicem versus fere deletis, singulatim macula sub-**

ovata infra callum humerale, plaga magna cuneiformi communi, a basi ad longe pone medium producta, alteraque oblonga, obliqua, pone medium posita, intus ad suturam adfixa cyaneis; scutello nigro.

Long. $3\frac{1}{2}$ lin.

Hab. Australia, Rockhampton.

Antennæ moderately robust, more than half the length of the body; second joint short, third and fourth equal, ovate, each one half longer than the second. Thorax twice as broad as long; sides straight and parallel, rounded and converging at the apex, anterior angles obtuse; upper surface excavated on either side at the base, the excavations deeply punctured; disk smooth, impunctate. Elytra broader than the thorax, oblong, less acutely rounded at the apex than in the preceding species.

Fam. **Gallerucidæ**.

Subfam. HALTICINÆ.

Genus NIPHRÆA.

Corpus subelongatum, modice convexum. *Caput* modice exsertum; *antennis* filiformibus, 11-articulatis; *oculis* prominulis, integris; *encarpis* contiguis; *carina* oblonga. *Thorax* transversus, basi transversim truncatus, disco ante basin sulco transverso, utrinque ad marginem lateralem extenso, impressus. *Elytra* thorace multo latiora, oblonga, punctato-striata, pube sericea sat dense vestita. *Pedes* simplices; *femoribus* posticis incrassatis; *tibiis* apice spina acuta armatis; *tarsis* posticis ad tibiæ apicem insertis; *unguiculis* appendiculatis. *Prosternum* angustatum; *acetabulis* anticis apertis.

Type *Niphræa hirtipennis*.

Closely allied to *Trichaltica*, but separated from that genus by the transverse groove of the thorax, which in the present case extends entirely across the base of the thorax.

Niphræa hirtipennis.

N. subelongata, modice convexa, fulva, nitida, antennis extrorsum nigro-piceis, pectore, abdomine (apice excepto) elytrisque nigris; his pube griseo-argentea sat dense vestitis, granuloso-rugulosis, subopacis, fortiter punctato-striatis, limbo exteriore, apice ampliato, fulvo.

Long. $2–2\frac{1}{2}$ lin.

Hab. Lake Nyassa.

Vertex smooth, impunctate; encarpæ subpyriform, contiguous; antennæ nearly half the length of the body, third joint

equal in length to the second, fourth twice as long as the third. Thorax one half as broad again as long; sides diverging from the base to beyond the middle, thence rounded and converging to the apex; disk finely but distinctly punctured.

Fam. **Hispidæ.**

Cephaloleia gracilis.

Filiformis, subdepressa, nigro-picea, subnitida, minute granulosa, antennis basi, pedibus, thoracis lateribus elytrorumque plaga basali rufo-brunneis; thorace subquadrato, foveolato-punctato; elytris elongatis, apicem versus attenuatis, apice late truncatis, sat fortiter punctato-striatis, interspatiis basi et ad latera convexiusculis, singulatim vitta alba, basi et apice abbreviata, ornatis. Long. 2 lin.

Hab. Amazons.

Face and front concave, coarsely punctured; five lower joints of antennæ obscure rufo-piceous, the rest black. Thorax scarcely broader than long; sides straight and parallel, slightly converging towards the apex; anterior angles very obtusely rounded, the hinder angles acute; basal margin subangulate-emarginate on either side; median lobe only slightly produced, obtusely rounded; upper surface transversely convex, impressed with large round punctures, a longitudinal space on the middle disk impunctate; extreme lateral margin rufo-brunneous. Scutellum obscure piceous. Elytra elongate, slightly wider at the base than the thorax; basal margin oblique, the humeral angle distinct; sides straight and parallel, slightly converging towards the apex, the latter broadly truncate.

Cephaloleia subdepressa.

Elongato-ovata, subdepressa, castanea, subnitida, pedibus obscure fulvis, antennis (articulis basalibus tribus exceptis) nigris; thorace sat fortiter punctato, piceo, lateribus castaneis; elytris ovatis, distincte punctato-striatis, interspatiis minute granulosis, ad latera convexiusculis, pone scutellum leviter transversim rugulosis.

Mas abdominis segmento anali concavo-emarginato.

Fœm. abdominis segmento anali rotundato, integro.

Var. A. elytris plus minusve piceo tinctis.

Long. 1¼ lin.

Hab. Banks of the Amazon.

Face distinctly but not strongly punctured. Thorax about a third broader than long at the base; sides straight and nearly parallel in the ♂, less parallel in the ♀, rounded at the apex in both sexes; basal margin deeply concave-emargi-

nate on either side, median lobe distinctly produced, obtusely truncate; upper surface covered with round punctures, middle disk less closely punctured.

Gonophora tibialis.

Subelongata, subdepressa, pallide rufo-fulva, nitida, elytrorum dimidio postico antennisque nigris, harum articulo basali intus ultimisque duobus totis obscure rufis; thorace medio longitudinaliter canaliculato, basi ante scutellum transversim sulcato, utrinque ante medium vitta elevata instructo, rude et crebre foveolato, interspatiis elevatis, inter se reticulatis; elytris anguste oblongis, fere parallelis, apice obtuse truncatis, angulis posticis distinctis, obtusis, singulatim profunde 8-seriatim foveolatis, tricostatis, costis duabus internis valde elevatis, costa externa medio interrupta; tibiis anticis compressis, valde dilatatis.
Long. 3 lin.

Hab. Sulu Islands, New Guinea.

Head smooth, impunctate; anterior margin of clypeus deeply concave; antennæ half the length of the body, first and second joints short, equal, third nearly twice the length of the second. Thorax transverse; sides straight and nearly parallel, abruptly constricted at the apex; surface closely covered with oblong foveæ, the interspaces between which are thickened and anastomose irregularly with each other; at the base just in front of the scutellum is a short deep transverse groove, from either extremity of which an oblique depression extends upwards on the disk. Elytra broader than the thorax, each with three raised longitudinal costæ; the two inner ones entire, strongly elevated, the outer one interrupted for the greatest portion of its length; interspaces between the costæ each with a double row of large deep foveæ, interstices between the foveæ transversely thickened; interspace between the first and second costa impressed at the base with a triple row of punctures; extreme apical margin edged near the suture with rufo-fulvous.

Gonophora lineata.

Elongata, flavo-fulva, nitida, tarsis nigro-piceis, genibus, tibiis anticis fere totis, tibiisque intermediis apice piceo tinctis; antennis nigris, articulo ultimo apice obscure rufo; thorace convexo, basi ante scutellum transversim sulcato, utrinque ante sulcum oblique depresso, foveis numerosis magnis impresso, linea media discoque antico fere impunctatis: elytris thorace latioribus, parallelis, apice rotundatis, minute serratis, dorso subdepressis, singulatim tricostatis, costis duabus internis validis, costa externa minus elevata, medio obsoleta, interspatiis profunde biseriatim foveolatis, transversim costulatis; nigro-piceis, costa prima a basi fere ad

apicem, costa secunda ante medium (his costis basi convexis) margineque exteriore flavis.

Long. 2½ lin.

Hab. Sulu Islands, New Guinea.

Antennæ slender, more than half the length of the body; second joint slightly longer than the first, the third one half longer than the second, fourth and fifth each equal in length to the third. Thorax rather broader than long; sides straight and slightly diverging from the base to beyond the middle, thence converging and deeply sinuate to the apex; hinder angles produced laterally into a short stout tooth; above convex, cylindrical at the apex, flattened towards the base. Scutellum piceous, its apex broadly truncate. Apex of anterior tibia curved inwards and produced into an acute tooth.

Gonophora Horsfieldi.

Filiformis, nigra, nitida, tarsis piceis; thorace basi et apice rufopiceo, subcylindrico, ad latera foveolato-punctato, apice punctorum serie unica impresso, disco lævi, basi transversim sulcato et utrinque ante sulcum excavato; elytris subparallelis, apice obtuse rotundatis, minute serratulis, fulvis, apice nigris, singulatim bicostatis, costis valde elevatis, integris, interspatiis profunde biseriatim foveolatis, interstitiis apicem versus transversim costulatis; pedibus robustis.

Long. 2 lin.

Hab. Java.

Antennæ rather slender, more than half the length of the body, black, the two lower joints obscure piceous; first and second joints short, equal, the third rather longer. Thorax rather broader than long; sides rounded, constricted at base and apex, hinder angles produced laterally into a short obtuse tooth.

Gonophora crassipes.

Elongata, angustata, flava, nitida, tarsis antennisque piceis, his extrorsum nigris; elytrorum macula apicali nigro-picea; thorace transverso, parce foveolato-punctato, basi transversim sulcato et utrinque ante sulcum oblique impresso, apice cylindrico, serie unica punctorum impresso; elytris parallelis, apice rotundatis, integris, singulatim bicostatis, costis valde elevatis, integris, interspatiis foveis magnis biseriatim dispositis profunde impressis, interstitiis apicem versus transversim costulatis; tibiis crassis.

Long. 1¼ lin.

Hab. Kai Island.

Antennæ half the length of the body, seven lower joints obscure piceous, the rest black; first and following three joints

equal in length. Thorax with its sides obliquely diverging from the base to beyond the middle, thence rounded and converging to the apex, the latter abruptly constricted.

Cephalodonta Haroldi.

Cuneiformis, subdepressa, nitida, subtus nigra, thoracis lateribus, femoribus tibiisque rufo-fulvis; supra læte rufo-fulva, antennis nigris, articulis rufo variegatis; thorace subquadrato, lateribus obsolete angulatis, angulis anticis antrorsum productis; disco transversim convexo, ante basin transversim depresso, profunde foveolato-punctato; elytris a basi apicem versus leviter ampliatis, apice obtusis, leviter serratulis, angulo postico distincto, profunde foveolato-punctatis, punctis striatim dispositis, hic illic confusis, interspatiis ad latera et ad apicem elevato-vittatis, hic illic irregulariter verrucosis.

Long. $3\frac{1}{4}$–$3\frac{3}{4}$ lin.

Hab. Columbia, river Magdalena.

Nearly allied to *C. tarsata*, at once known by the coarser punctuation and by the irregular surface of the elytra.

VI.—*On the Minute Structure of the Corals of the Genera* Heliophyllum *and* Crepidophyllum. By H. Alleyne Nicholson, M.D., D.Sc., F.L.S., Professor of Natural History in the University of St. Andrews.

Genus Heliophyllum*.

Heliophyllum, Hall, in Dana's 'Zoophytes,' Explor. Exped. vol. viii. p. 356, fig. 3, 1846.

Gen. char. Corallum simple or compound, usually turbinate, cono-cylindrical or cylindrical, rarely massive. Increase, in the simple forms, by simple calicular gemmation. Epitheca complete, thin, with encircling striæ and annulations of growth. Tabulæ not complete, but confined to a more or less extensively developed central area. Septa well developed, of two orders, a greater or less number of the primary septa almost always passing inwards to the centre of the visceral chamber, where they become flexuous and unite with one another in an irregular network. In cross section the septa are invariably crossed by conspicuous cross bars or denticulations.

* Descriptions of the characters of *Heliophyllum* and *Crepidophyllum* formed part of a paper, by Mr. James Thomson and myself, which was laid before the Royal Society of Edinburgh in the session 1875–76, and an abstract of which was published in the 'Proceedings,' vol. ix. No. 95, p. 149.

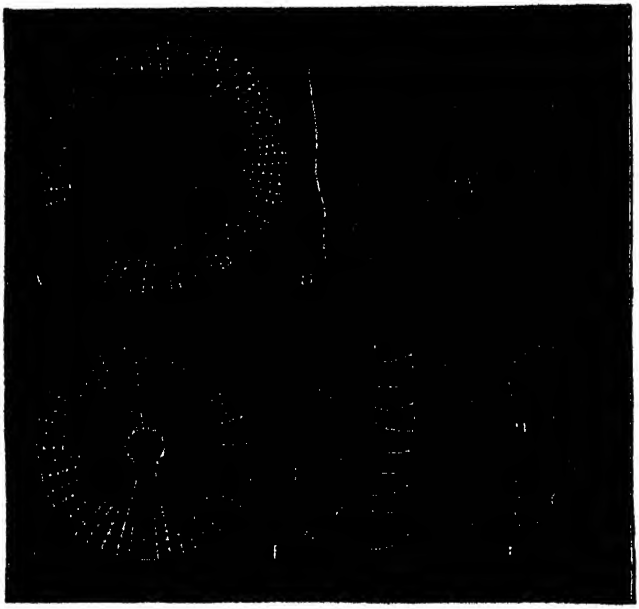
An external vesicular area feebly developed and often almost absent. Dissepiments of two orders :—those of the *first order* very strongly marked, and forming a series of strong ascending ridges, which run inwards and upwards in an arching manner, forming the cross bars on the septa as seen in transverse sections, and appearing on the free edges of the septa in the calice as so many spines or teeth; those of the *second order* being more delicate, and running in an arched manner inwards and downwards, often producing a greater or less amount of vesicular tissue in the exterior zone. No true columella is present; but those of the primary septa which reach the centre are often elevated to form a small eminence in the bottom of the cup.

In the typical species of *Heliophyllum* the corallum is essentially simple, and is usually more or less turbinate and conical in form, as in *H. Halli*, Edw. & H.; *H. canadense*, Bill.; *H. colbornense*, Nich.; and *H. elegantulum*, Nich. & Thoms. These primarily simple forms, however, very commonly produce buds by simple calicular gemmation (see a paper by the writer, Trans. Royal Soc. Edinb. vol. xxvii. p. 238), or by what Lindström has termed "uniserial gemmation." In these cases the polype, originally and essentially simple, sends up from its oral disk a *single* bud. The primitive calice may or may not be obliterated by the gradual growth and extension of the epitheca over it; and the secondary calice may or may not produce a tertiary bud in the same manner as that in which it was itself produced. Sometimes the process stops with the production of one or two buds; at other times it goes on by fits and starts, by periodic restrictions of growth and efforts at reproduction, till the corallum assumes the form of a series of short turbinate cups or inverted cones, superimposed upon one another in the same longitudinal axis, the younger upon the older. There are also not wanting instances, within the limits of the genus *Heliophyllum*, in which the old corallite throws out two, three, or more buds from its oral disk; though this process is never carried so far as to produce large compound masses. Finally, in one form at present referred to *Heliophyllum* (viz. *H. colligatum*, Bill.) the corallum is truly and essentially compound, forming large fasciculate masses of cylindrical and closely approximated corallites.

The epitheca is complete, usually thin, and marked with numerous delicate encircling lines, generally along with well-marked accretion-ridges.

The form of the calice varies. It is rarely of any great depth, as compared with the proportional bulk of the coral-

lum; and its floor may be flat, or may exhibit a small rounded eminence formed by the primary septa. The principal feature of importance presented by the calice is, that the free edges of the septa are invariably furnished with prominent spines, formed by the terminations of the ascending dissepiments.



A, cross section of *Heliophyllum Halli*, E. & H., of the natural size, showing the manner in which the septa are continued to the centre, and showing the arched ascending dissepiments, but having the other dissepiments omitted. B, vertical section of *H. Halli*, showing the central tabulate area, and both the ascending and descending series of dissepiments. C, cross section of *Crepidophyllum subcæspitosum*, the descending series of dissepiments being, as before, omitted: twice the natural size. D and E, cross sections of the same species, of the natural size. (D shows the central tabulate area completely closed in by the central tube; and E exhibits the cut edges of some of the delicate descending series of dissepiments.) F, vertical section of a fragment of the same species, twice the natural size, showing the central tabulate area, with its enveloping wall, and the ascending and descending sets of dissepiments. B is slightly generalized, and some details have been omitted. All the specimens are from the Hamilton group of the State of New York and of Ontario.

The internal structure of the corallum in *Heliophyllum* is somewhat complex, but is rendered readily intelligible by means of transverse and longitudinal sections. The tabulæ

are seen in longitudinal sections (fig. B) occupying a central area of variable width. As a rule the tabulate area is of comparatively small extent, and the tabulæ are somewhat remote and irregular; but sometimes these structures occupy a considerable space, and are arranged with considerable regularity and close together.

The septa (fig. A) are always very well developed; and both primary and secondary septa are invariably present, so far as I have observed. All the primary septa extend to the immediate vicinity of the centre of the visceral chamber; but a large number of them, sometimes all of them, stop short of the actual centre. They all, however, become more or less flexuous as they approach the centre; and, as a general rule, a certain proportion of them continue inwards till they become connected in a loose and irregular network, though they in no case form a central cellular mass. Nor is there, under any circumstances, any true columella. The secondary septa, again, are very well developed, and usually extend to at least half, or even two thirds, of the length of the primary septa. Lastly, both the primary and secondary septa exhibit in cross sections a variable number of conspicuous cross bars (fig. A), which give to them an exceedingly characteristic appearance, though this cannot be regarded as peculiar to the genus. These cross bars are confined to the exterior portions of the septa, and are wanting centrally. They are formed by the transverse section of the ascending dissepiments; and as they run directly across the septa, it is evident that the dissepiments are placed at corresponding points on the two sides of each septum. In no case, however, do the cross bars formed in this way extend from one septum to those directly contiguous to it, but they are always confined to their proper septum; and they do not correspond in position in neighbouring septa.

The most characteristic features in the structure of *Heliophyllum* are due to the very remarkable form and arrangement of the dissepiments—an arrangement which has been (but erroneously) supposed to be peculiar to this genus. There are two groups or orders of dissepiments (fig. B), which intersect one another nearly at right angles, those of the one series having an ascending direction as regards the corallum, whilst those of the other are descending. The dissepiments of the ascending series form a group of strong curved ridges, directed in an arched manner upwards and inwards from the wall towards the centre, with the convexities of the arches upwards. When seen in longitudinal sections, they are never continuous from the wall to the free edges of the septa, but they

appear as successive rows of discontinuous ridges. Nor do they ever extend so far from any one septum as actually to reach the septa immediately contiguous to it. On the contrary, they occur in reality as so many strong ridges which are developed on the sides of each septum, and always in precisely corresponding positions on the two sides of any given septum. Hence it is that they appear in the calice as so many spines on the free edges of the septa, and in cross sections as so many cross bars intersecting the septa. Hence, also, in silicified specimens, in which the interior is exposed, they appear as curved striæ or ridges on the otherwise plain sides of the septa; and this appearance is not due to any disappearance or destruction of the dissepiments subsequent to the death of the polype, but is really due to the inherent form of these structures.

The dissepiments of the second order are exceedingly delicate, and are much less marked than those of the preceding series, which they intersect approximately at right angles. They are directed inwards and downwards, from the wall to the centre of the visceral chamber, and they are continuous between contiguous septa. They form a series of lenticular vesicles, which are seen in longitudinal sections (fig. B) to be arranged in oblique rows, directed inwards and downwards, with their convexities upwards. The extent to which they are developed, however, varies greatly in different cases; and though they are always preeminently developed in the outer portions of the corallum, they are never present in such numbers as to give rise to the conspicuous exterior zone of vesicular tissue which forms such a marked feature in corals such as the typical *Cyathophylla*.

The genus *Heliophyllum* owes its name to the eminent American palæontologist, Prof. James Hall; but its first publication was in Dana's great work on the corals (*op. jam cit.*). It was originally regarded as nothing more than a subgenus of *Cyathophyllum*; and no higher rank is assigned to it by Dana than this. In reality, however, it cannot be placed even in the immediate vicinity of *Cyathophyllum* proper, with which it has hardly any characters in common. Though this constitutes the first published description of the genus, it had been figured previously to this date, as the *Strombodes helianthoides* of Phillips ('Palæozoic Fossils,' pl. v. fig. 13, 1841) appears to be undoubtedly a species of *Heliophyllum*.

The first description giving any thing like a really accurate conception of the structure of the corallum in the genus *Heliophyllum* is that published by Milne-Edwards and Haime (Pol. Foss. des Terr. Pal. p. 408). They define the genus as

follows :—" Corallum simple, subturbinate. Septa well developed, and giving origin laterally to lamellar prolongations, which are directed from the wall towards the centre, in an ascending and arched direction, so as to constitute irregular tabulæ in the central area. These lamellar prolongations are united circumferentially by vertical plates." This definition, however, is not only deficient in its details, but it is erroneous in the important point that the tabulæ of the central area are considered as formed by prolongations from the ascending dissepiments, whereas these structures, in reality, are wholly independent of one another.

By Mr. Billings (Can. Journ. new ser. vol. iv. p. 124) the genus *Heliophyllum* is defined as follows :—" Corallum simple or aggregate; radiating septa well developed, obliquely striated on their sides by thin elevated ridges, which extend from the outer wall towards the centre. These ridges are connected by numerous thin laminæ which divide the spaces between the septa into small sublenticular cells. The transverse diaphragms are thin, flexuous, and confined to the central portion of the coral." This definition likewise omits many characters of importance; and the distinguished Canadian palæontologist is certainly in error in concluding that " the only difference between this genus and *Cyathophyllum* is the absence of the curved striæ from the septa of the latter."

By Dybowski (Mon. der Zoanth. scler. rug. aus der Silurformation &c. p. 83) the genus *Heliophyllum* is placed in a special family, Craspedophyllidæ, along with the two new genera *Acanthophyllum* and *Craspedophyllum*, the only characters assigned to the family being that there is no accessory wall, that the septa are complete, and that the sides of the septa are furnished with lateral outgrowths. As all these characters, however, might be predicated of other genera, it will hardly be possible to retain this family as it is at present constituted. Finally, a description of the generic characters of *Heliophyllum*, drawn chiefly from the beautiful silicified specimens of the Corniferous Limestone of North America, was published by the present writer ('Rep. on the Palæontology of Ontario,' part i. p. 24, 1874).

As regards the affinities of the genus *Heliophyllum*, it is certainly related to *Cyathophyllum*; but the differences between these two genera are so many and so great that it cannot be said that the relationship is by any means a very close one. If we confine our attention to the simple and more typical members of the genus *Cyathophyllum*, the chief points of relationship with *Heliophyllum* are to be found in the presence of an external vesicular area in both groups, in the

restriction of the tabulæ to a comparatively limited central zone, and to the fact that a certain number of the septa pass inwards to the centre, where they become more or less twisted together. Even in these points, however, the agreement is far from complete. In *Cyathophyllum* the exterior zone of vesicular tissue is invariably present, is largely developed, and is composed of very numerous minute cells; in *Heliophyllum* this zone is never largely developed, is sometimes altogether wanting, and is always composed of comparatively large cells, so as never to constitute a really conspicuous feature. Again, in the typical *Cyathophylla* the primary septa extend inwards to the centre, where they are twisted together so as to form a sort of spurious columella; in *Heliophyllum*, on the other hand, it is never more than a comparatively limited number of the primary septa which are continued inwards to the centre of the visceral chamber, and these, instead of becoming twisted together, unite with one another to form a loose and irregular network. When, however, we come to examine the differences between these two genera, they are found to materially outweigh the points of similarity. The species of *Heliophyllum* are, more particularly, fundamentally distinguished from those of *Cyathophyllum* by the presence of the peculiar arched lamellæ which are directed inwards and upwards along the sides of the septa, appearing on the free edges of the septa within the calice as so many teeth or spines, and constituting the characteristic cross bars by which the septa are seen in transverse sections to be intersected at regular intervals. No structure in any way capable of confusion with this has ever been detected in any *Cyathophyllum*.

Lindström has suggested that *Palæocyclus*, E. & H., will probably be found to be allied to *Heliophyllum*; but I am unable to confirm this suggestion. The free edges of the septa in *Palæocyclus* are denticulated in a manner superficially similar to what is seen in *Heliophyllum*; but vertical and transverse sections show that this denticulation is produced in a different way. At the same time the form of the corallum in *Palæocyclus* is quite unlike that of *Heliophyllum*, and the discoid forms are wholly destitute of tabulæ.

The nearest ally to *Heliophyllum* is undoubtedly the genus *Crepidophyllum*. In this genus we find the central tabulate area of *Heliophyllum* and the same scantily developed external vesicular area; whilst the free edges of the septa are rendered denticulate, and their transverse section is cross-barred by the same series of strong lateral arched lamellæ. In many respects, therefore, we find a complete resemblance between *Heliophyllum* and *Crepidophyllum*. At the same time the

latter is distinguished fundamentally by the fact that the central portion of the tabulate area is enclosed by a distinct and separate wall, with which the primary septa become directly connected, the central space thus enclosed usually opening at one point to form a wide fossette bounded by two primary septa and containing two or three short septa.

There is also a close relationship between *Heliophyllum* and *Phillipsastræa*, E. & H. The edges of the septa are occasionally denticulated in the latter genus in a manner apparently similar to that which obtains in *Heliophyllum*; and there is also a small central tabulate area. How far this resemblance is really founded upon identity of structure, I am not at this moment in a position to determine. At any rate, the genus *Phillipsastræa* is readily distinguished from *Heliophyllum* by the fact that the corallites of the former are wholly destitute of a proper wall, and become united by the confluence of septo-costal radii.

It may be mentioned, finally, that there are some species at present referred to *Acervularia* (such as *A. profunda*, Hall, and *A. Davidsoni*, E. & H., both from the Devonian formation) in which the edges of the septa are denticulated, and their transverse section cross-banded, as in the genus *Heliophyllum*. The more intimate structure of these forms, however, still awaits elucidation.

So far as at present known, the genus *Heliophyllum* is exclusively restricted in its range to the Devonian formation, being known to occur in both the New and the Old World at this horizon.

Crepidophyllum, Nich. & Thomson.

Crepidophyllum, Nicholson and Thompson, Proc. Roy. Soc. Edinb. vol. ix. no. 95, p. 149.

Corallum simple or compound—in the former case cylindrical or cono-cylindrical, in the latter case forming large fasciculate masses. Increase by lateral gemmation in the compound species. Epitheca complete, thin, with encircling striæ and conspicuous annulations of growth. Tabulæ not complete, but confined to a more or less extensively developed central area, the median portion of which is enveloped in a distinct accessory wall, and thus shut off from the rest. The median tabulate tube (fig. C) thus formed may be completely enclosed; but more commonly it is open at one point, and the two extremities of the horseshoe thus formed become directly continuous with two of the primary septa, which in this way include a wide septal fossula, within which are contained two or three short septa. The remainder of the primary septa are well

developed, and extend from the epitheca to the accessory wall surrounding the central tube, with which they become directly connected. The primary septa never, however, extend into the interior of the central tube; and they alternate with well-developed secondary septa of more than half their own length. The calice is moderately deep, and exhibits at its bottom a small flat space formed by the upper end of the central tabulate tube. The free edges of the septa within the calice are denticulated; and the cross section of the septa shows them to be intersected by conspicuous cross bars, these appearances being produced by a series of strong arched lamellar dissepiments, which are developed at corresponding points on the two sides of each septum, and are directed upwards and inwards towards the centre. There is also a second series of more delicate dissepiments, which connect the septa with one another, are directed downwards and inwards, and give rise in longitudinal sections to a larger or smaller amount of exterior vesicular tissue.

It will be seen from the above description, that in many respects there is a very close relationship between *Crepidophyllum* and *Heliophyllum*. This is especially seen in the structure of the endothecal dissepiments, which are precisely the same in the two genera. In both we have a double series of dissepiments (figs. B & F), which intersect one another at high angles, those of the first series running upwards and inwards, and those of the second series running downwards and inwards. In both, the dissepiments of the first series are so far peculiar that they do not actually connect contiguous septa, but have the form of strong curved or arched ridges, which are developed on the sides of the septa and at precisely corresponding points on the opposite sides of each individual septum. Hence in both genera the dissepiments of this series give rise to three very characteristic and peculiar appearances: (1) the free edges of the septa in the calice are marked with blunt spines or teeth; (2) the sides of the septa, as seen in longitudinally fractured specimens, exhibit a series of pronounced striæ or ridges, directed upwards and inwards in an arched manner, with their convexities upwards; and (3) the cross section of the septa, both primary and secondary, shows them to be intersected by conspicuous cross bars. In both *Crepidophyllum* and *Heliophyllum*, again, we find a second series of dissepiments, which are much more delicate in structure, and are directed approximately inwards and downwards, and which actually connect contiguous septa with one another. These dissepiments are seen, in longitudinal sections, to form a series of comparatively large-sized vesicles,

which are strongly arched and have their convexities directed upwards. Though most largely developed in the external parts of the coral, the vesicles formed by the dissepiments of this series are variable in amount, and can hardly be said to constitute a distinct exterior vesicular zone, such as is so characteristic of the true *Cyathophylla*.

With these remarkable points of agreement we find the following equally remarkable points of divergence, by which *Crepidophyllum* is distinguished not only from *Heliophyllum*, but from all other known genera of the Rugose Corals:—(1) The central tabulate area, in most respects, closely resembles that of *Heliophyllum*, the tabulæ being remote, often more or less arched, and sometimes uniting with one another. The central portion of this area, however, is shut off from the rest of the visceral chamber by a secondary investment or accessory wall, so that there is constituted a kind of central pipe or tube (fig. F), which is crossed by the tabulæ, and runs down the centre of the corallum. (2) The central tabulate tube thus constituted, however, is only rarely quite complete: usually it is open on one side, and its investment or wall becomes continuous at this opening with two of the primary septa, which run to the margin of the corallum. (3) By means of these two primary septa and the secondary wall there is thus enclosed a large, somewhat horseshoe-shaped septal fossula (fig. C), within which are contained two or, more commonly, three short septa. (4) The remaining primary septa are continued inwards till they meet the wall of the central tube, with which they become coalescent. They do not, however, extend into the interior of the tube; and there is therefore no similarity between their arrangement and that which obtains in *Heliophyllum*, where a certain number of the primary septa pass inwards to the centre of the visceral chamber, and become loosely connected with one another there. Indeed I am not acquainted with any genus in which any close approximation to the peculiar structure of the central portion of the corallum in *Crepidophyllum* can be found. There is no other recorded genus in which the median portion of the central tabulate area is partitioned off by a distinct wall, with which all the primary septa are connected directly, and in which they terminate.

The genus *Crepidophyllum* contains two species of corals from the Hamilton formation (Devonian) of North America. One of these corresponds with a portion of the group of forms which I formerly described under the name of *Heliophyllum subcæspitosum* (Geol. Mag. new ser. dec. ii. vol. i. p. 58, pl. iv. fig. 9); and as it comprises the most typical members

of this group, it must now be known under the name of *Crepidophyllum subcæspitosum*. The remaining forms originally included under the title of *H. subcæspitosum* are really referable to *Heliophyllum*, of which they constitute a separate species (*H. elegantulum*, Nich. & Thomson). The other form of *Crepidophyllum* is the large compound coral which was originally described by Mr. Billings under the name of *Diphyphyllum Archiaci*, but which turns out on microscopic examination to be unquestionably a species of *Crepidophyllum*.

VII.—*On Two New and remarkable Species of* Cliona. By W. J. Sollas, M.A., F.G.S., &c.

[Plates I. & II.]

1. *Cliona mucronata* (mihi).

(Examined in the dried state.)

Sponge occupying a number of chambers excavated in the solid calcareous base of a species of *Isis*.

Chambers of various forms, oval, spherical, or irregular, joined together in a single series or in more complex groups by constricted apertures or by narrow stolon-like tubes, each of which is usually furnished with a spicular diaphragm.

Spicules of three kinds:—1, a straight acuate (Pl. II. figs. 1–3), having a cylindrical shaft, which terminates at one end in a more or less spherical head and at the other is rounded off bluntly and then produced axially into a short sharp spine or mucrone; average length 0·004 inch, breadth across the head and rounded end 0·0006, and across the neck 0·0004, mucrone about 0·0002 inch long. 2, a slender pin-like acuate (Pl. II. figs. 6, 7), straight or curved, with a more or less spherical head and a sharp point; length 0·0073 inch, breadth across the head 0·0004, across the shaft 0·0002. 3, a minute or flesh-spicule (Pl. II. fig. 9), body spirali-sinuously curved once or oftener, or straight, irregularly spined; length 0·0006 inch.

Diaphragms irregularly disciform (Pl. I. figs. 2, 3, 6), conical (figs. 5, 9), or tubular (figs. 4, 10) and open at both ends; when conical, perforated by the truncation of the apex (fig. 5) or imperforate (fig. 9); circumferential edge of disk-like forms, or the base in the case of the other two forms, attached to the walls of the containing tube or constricted aperture, across which the diaphragm extends transversely. Composed chiefly

of the goad-like or first kind of spicules, which are packed closely together side by side, normal to the walls they form (fig. 14)—their globular heads forming the exterior (fig. 15), and their mucronate ends the interior surface of the diaphragms. The interstices between the spicules filled with a tough brownish-coloured kerataceous cement. A number of both the goad-like and the slender pin-like spicules lie on the outer surface of the diaphragms, some taking a circumferential and others a longitudinal direction; in the case of the disk-like and imperforate conical forms, these radiating superficial spicules form a wisp-like cap (fig. 9) over the apex or the centre as the case may be, over which also their points meet and cross one another, while their heads are turned towards the circumferential edge. A few of the minute flesh-spicules occur along with the others; and thus the spiculation of the diaphragms is as complete as that of the sponge.

The diaphragms have a constant thickness, viz. that of the length of the goad-like spicules; but they vary in diameter according to the size of the aperture they fill.

Habitat. In the calcareous skeleton of *Isis*, sp. (Deciduous specimen.)

Locality. (?)

Remarks. In examining the débris from a specimen of *Isis*, sp., which I had broken to pieces for another purpose, I came across one of the singular mucronate spicules which form the staple spicule of this sponge; and taking it to belong to some unknown member of the Suberitidæ, I set to work to discover the organism from which it had been derived. I then found certain curious patelliform bodies (the diaphragms already described), which on examination proved to be mainly composed of this kind of spicule; but since these bodies were wholly unlike any sort of sponge with which I was acquainted, I concluded that they were wanting in some of their parts, and continued my search in the hope of discovering one more perfect than the rest; then I met with them, *in situ*, in the chambers of our *Cliona*, to which they evidently belonged. Now arose a question as to their real relations to this sponge. And here only two alternatives presented themselves to my mind: either they were in some way connected with its propagation, embryos or "seed bodies;" or else they performed the office of septa or diaphragms. But the only known method of propagation amongst the Clionidæ is by means of ova, which they produce plentifully, giving rise to ellipsoidal gastrulæ provided with all the forms of spicule proper to the adult sponge. Thus the possession of a full complement of spicules is a character common to the bodies under considera-

tion and to the embryos of the *Cliona.* On the other hand, however, in the embryos of *Cliona* no wisp-like cap has been observed; and no known embryo of *Cliona* or of any other sponge exhibits the regular and close arrangement of spicules which is to be seen in the walls of our structures; the spiculation of the young *Cliona* is in the highest degree confused, presenting no trace of order or arrangement. These facts are sufficiently important; but when in addition we find the diaphragms, as we may as well call them at once to avoid periphrasis, exhibiting such a great diversity of form and size, and this always in exact correspondence to the size and shape of the orifices or tubes they occupy, and when, moreover, we find them invariably attached to the sides of these tubes or orifices by one circumferential edge, we must, I think, exclude from the question all notion of attributing an embryonic nature to them.

There then remains, so far as I can see, only the other alternative; and the facts which tell most strongly against the previous supposition are just such as lend most support to this, the complete justification of which is to be found in the constancy with which the diaphragms occur just at the apertures of communication between adjoining chambers and no where else. This is an adaptation which Mr. Carter tells me is not to be found in the case of the embryos of *Cliona*; but there can be no doubt about its existence here. By an observer examining the chambers of our *Cliona* for the first time, it might perhaps be for a moment called in question, since on looking into one of these chambers one may sometimes see, as if simply adhering to its walls, some four or five diaphragms looking just like so many limpets seated on the walls of a hole in a rock, and giving one no hint as to the existence of apertures concealed beneath them; if now, however, we remove these little bodies one by one with a fine needle, we shall disclose beneath each a corresponding opening leading directly into an adjoining chamber. This experiment I have performed several times, and always with the same result. That these organs are peculiar to the constricted apertures can therefore admit of no reasonable doubt; and their diaphragmatic nature seems to follow as a matter of course.

Why such diaphragms should exist, what is their precise function in the economy of the sponge, is another question, and one to which, in the absence of accessible evidence, I do not feel much inclined to hazard an answer; though if one must conjecture, one might suggest that they may act like the fixed ventilating partitions in a mine, shutting off communication in some directions, leaving it open in others, and so

determining the path taken by the currents of water coursing through the canal-system of the organism—or, again, that they may perhaps serve to differentiate the sponge into separate individuals. In some instances, however, every aperture in a chamber seems to be provided with an imperforate form of these diaphragms, so as to be completely sealed up from all means of communication with its neighbours. I say "seems," since it is difficult to make this out with certainty, and I have some doubt on the matter. Admitting, however, that I have determined this point correctly, then the whole arrangement suggests that of the seed of the freshwater *Spongilla*; for in such a chamber we have a particle of the sponge more or less spherical in shape, completely surrounded on all sides by an enclosure, which, while chiefly consisting of the calcareous walls of the chamber, yet does, when these are incomplete, possess also a wall of spicules set at right angles to its surface, and thus very much resembles the arrangement of the amphidisks about the seed-like body of *Spongilla*. We might have here, then, a case of physiological adaptation, the existence of the calcareous chamber-walls making possible an economy of spicules, and dispensing with the necessity of a complete spicular enclosure. Thus, when the sponge went into winter quarters, all that would be necessary would be the plugging up of the apertures in its burrows; and on the return of more genial conditions the growth of these plugs into perforated cones and open tubes would provide for the egress of the reviving sponge.

Plausible as this may appear at first sight, it will not, I think, bear a close investigation. In the first place *Cliona* has not yet been proved to produce "seed-like bodies;" and though this evidence is merely negative, it is yet of great weight, if we consider that in no marine sponge whatever have these structures been discovered, and that in *Spongilla* they are probably due to the influence of extreme changes in climatal conditions, to which the marine sponges are not exposed. Again, had the diaphragms of a single chamber formed collectively parts of a single enclosure, one would expect to find the heads of their spicules all turned in one and the same way—that is to say, either outwards or inwards relatively to the chamber. This, however, is by no means the case; no rule is to be discovered in this respect. Take for instance Pl. I. fig. 3, where two of the diaphragms, *a* and *b*, will be seen to have their surface of spicular heads turned towards the interior their respective chambers A and B, while a third, *c*, has it turned just the other way, or outwards towards the exterior. It may be said, however, that this diaphragm belongs more

especially to chamber C than to B, and that, accordingly, we must rather consider the fact that its spicular heads point towards the interior of C, than that they point away from the interior of B. An inspection of fig. 6 will at once furnish us with an answer to this argument, so far as it can be called argument; for there we find two diaphragms, the relation of which to their respective chambers is clear enough, *a* evidently belonging to chamber A, and *b* to B, while, at the same time, the position of the surface of spicular heads is reversed in each case, in *a* the points and in *b* the heads of the spicules being turned towards the interior of the respective chambers. In some cases, moreover, I have seen a diaphragm placed obliquely across an aperture where two chambers open into a third, and evidently so arranged as to determine a passage into one rather than into the other.

It seems then, to my mind, that whatever the ultimate function of these bodies may be, their immediate morphological relation to the sponge is that of open or closed partitions between adjoining chambers; and the term "diaphragm" is therefore the most appropriate to them.

The composition of the diaphragms may be best determined by placing one on a glass slide, adding a few drops of nitric acid, and boiling over a spirit-lamp till the acid has nearly all evaporated; a few more drops must then be added, and the operation repeated as many times as may be necessary for the solution of the kerataceous cement which binds the spicules together. When this has been accomplished, the acid must be driven off completely by continued heating, and the spicules mounted on the same slide as has served for their preparation: no attempt must be made to wash them with distilled water, or to transfer them to another slide; either of these operations is sure to result in the loss of some or all of the small flesh-spicules with which the diaphragms are but sparingly supplied.

By examining the edge of one of the diaphragms as an opaque object, under an objective magnifying about 100 diameters, the arrangement of its spicules can readily be made out; and no arrangement could be simpler (Pl. I. fig. 14). The more or less cylindrical spicules lie side by side, their mucronate extremities forming the inner and their globular heads the outer face of the diaphragm, so that the latter looks like a pavement of glass marbles (Pl. I. fig. 15), all of the same size, and packed as closely as possible, and in consequence exhibiting a quincuncial pattern; the inner face has very much the same appearance, with the single difference that from each marble of its pavement a small spike stands out erect. Across

the open end of those diaphragms that are perforated, a thin film of dried protoplasm or structureless membrane extends (Pl. I. fig. 10, *f*), with a small central or excentric lumen (fig. 10, *l*). In the membranous film a few spicules are usually present.

There can be no doubt as to the attachment of the diaphragms; for on removing one from its chamber it often leaves behind it a row of adherent spicules.

On examining the interior of the chambers of the *Cliona* one finds its body-spicules lying full length against the walls, without any tendency to a regular arrangement; one also finds fragments of structureless membrane adhering loosely to the walls, or lying freely in the interior of the chambers, and in these each of the different spicules of the species are contained. Small rounded granular bodies (Pl. I. fig. 12, *c*, and fig. 18) also occur rather plentifully in these bits of membrane; and since they sometimes contain vacuoles (fig. 18, *b*), we may regard them as desiccated cells.

The walls themselves are pitted all over with hemispherical excavations (fig. 8) having rounded edges, and usually about 0·001 inch in diameter. These, which are usual, I suppose to be the first results of the solution by which the *Cliona* excavates its abode.

Little circular openings (Pl. I. fig. 16) are also visible on the sides of the chambers, and become much more clearly exposed after washing the chambers with a little dilute acid; they lead into tubular processes of variable length, generally simple, sometimes bifurcating, and apparently terminating blindly.

On the outside of the *Isis* containing the *Cliona* may be seen a number of rounded holes (Pl. I. fig. 17), by which the chambers with which they communicate freely open to the exterior. These holes are not very abundant; indeed I have been surprised not to find more of them. They occur in groups, and appear to be of two kinds—one larger (fig. 17, *o*), serving probably for the oscules of the sponge, and the other smaller, for its pores (fig. 17, *p*). Generally in the *Clionidæ* they present a crown of pin-like spicules pointed outwardly.

On dissolving a fragment of the infested *Isis* in acid we liberate the spicules it contains, and then find not only the forms we have already described, but a number of others of quite a different character, particularly the abundant sword-like forms, of which instances are exhibited in Pl. II. figs. 10, 11. At first I thought these were proper to our species *C. mucronata*; and since they appeared to be more numerous in its chambers than the mucronate forms, I set them down as

its body-spicule, and regarded the mucronate spicules as more or less peculiar to the diaphragms; but after meeting with sponges of other genera, such as *Stelletta*, in the chambers of our *Cliona*, I began to suspect that the sword-like spicules might belong to a different species—a supposition which became confirmed on finding diaphragms in which the sword-like spicules were the chief constituents, to the entire exclusion of mucronate ones. This led me to examine each chamber of the *Cliona*-burrows separately by reflected light; and I then found that those chambers which were provided with diaphragms of mucronate spicules exhibited the same spicules scattered over their walls, and, similarly, that chambers in which ensiform spicules were present were closed by diaphragms into the composition of which ensiform spicules chiefly entered. The spiculation of each chamber was pure; those that contained mucronate spicules never contained ensiform ones, and *vice versâ*. To make quite sure of this, I then proceeded as follows:—Under a magnification of about 50 diameters I picked out a cell, the openings to which were guarded by diaphragms of one kind or the other, say of mucronate spicules; the edge of this cell was then marked by a fine-pointed pencil for the purpose of identification. Next I drew out two pieces of glass tubing to very fine capillary terminations, and filled one with water and the other with dilute hydrochloric acid; working now under a watchmaker's glass, I inserted the capillary end of the tube containing acid into the marked chamber, and expelled a drop of the acid into it. By the resulting solution of its walls its spicules were detached and set free, so that it only remained to introduce the capillary end of the other tube into the chamber, and by forcing out the water in a fine jet to wash its contents into an excavated glass slide, where they could be examined by transmitted light. This operation I performed many times, and so convinced myself of the complete correspondence between the spicules composing the diaphragms and those lying on the walls of the same chamber. Similarly the fragments of dried sarcode present in some of the chambers always contain the same kinds of spicule as the associated diaphragms.

Finally, having made sure that I had present in my specimen of *Isis* two species of *Cliona*, the chambers of which appeared to be inextricably entangled with each other, I was able by a little careful searching to trace out the distribution of each; and I then found that the chambers of one species never opened into the chambers of the other, but that communicating chambers were always occupied by one and the same species. This is indicated in Pl. I. fig. 1, where the

cells left unclosed are those of *C. mucronata*, while the ones shaded with dark lines belong to the next species, *C. ensifera*. Here and there apparently isolated chambers of one or the other species occur, as those of *C. ensifera* at *a*; these, however, are not really isolated, but communicate with chambers of the same kind either above or below the plane of the drawing. We have now thus brought to light what appears to me a very remarkable fact, and one that might easily lead to great confusion in species; for nò one examining the burrows in my specimen of *Isis* would have supposed them to contain two different kinds of sponges. In the outline and arrangement of the chambers themselves no difference is to be detected; and but for a little care the different kinds of spicules within them would certainly have been described as belonging to one and the same species. The necessity for great caution in deciding what spicules to eliminate and what to retain in determining the true complement of spicules proper to a sponge has already been illustrated by the researches of Carter, who has had frequently to disentangle the spicules of commingled species one by one as it were, and so, by immense care, has arrived at correct results where failure would otherwise have been certain.

2. *Cliona ensifera* (mihi).

Sponge burrowing in chambers of the same kind as in the preceding species. Spicules of three kinds:—1, an acuate spicule (Pl. II. figs. 10, 11), having a straight or curved shaft, which is cylindrical in form for a certain distance from the globular pin-like head, and then expanding becomes fusiform for the rest of its length, and finally terminates in a more or less abrupt point: length 0·0095 inch; breadth across the head and broadest part of the shaft 0·0006, and across the neck 0·0002 inch. 2, a slender acuate (Pl. II. figs. 12, 13), straight or curved; inflated head variable in shape, spherical and ellipsoidal; dimensions variable, averaging 0·0075 inch in length and 0·0004 in breadth. 3, a minute or flesh-spicule (Pl. II. fig. 15), with a straight or curved shaft produced into a number of unequal conical spines; length 0·0006 inch. Diaphragms in shape and position very similar to those of *C. mucronata*, though slightly more irregular in outline, composed of ensiform spicules which lie side by side normal to the walls. Owing to the fact, however, that these spicules are as often curved as straight, they frequently depart from a normal position and are arranged obliquely, forming curved radii about the axis or centre of the diaphragm. The heads of the spicules form the outer surface of the diaphragm as in *C.*

mucronata; but sometimes they project for greater or less distances from the surface, so as to render it irregular. Besides the single layer of spicules, which forms a wall as thick as they are long, there are sometimes present additional ensiform spicules, which, lying in the same direction as the others, are stuck into the diaphragm like pins into a pincushion, and so increase its thickness to once and a half the length of a single spicule. The additional spicules are only held together by the insertion of their points; no kerataceous cement is present between the projecting ends of their shafts, which consequently form a white layer—in striking contrast to the yellow colour of the rest of the diaphragm, in which kerataceous matter occurs (Pl. I. fig. 11).

On the surface of the diaphragms all the kinds of spicules which characterize the sponge are scattered irregularly. The combination of two diaphragms to form a single one is of frequent occurrence in this species; and from it results the form shown with two centres in Pl. I. fig. 13, where about each centre the smooth shafts of the spicules form the curved radii of a circular area distinguished by the absence of spicular heads, which, however, are abundant enough outside the circumference of the circular area.

Remarks. The spicules represented by Pl. II. figs. 1, 6, 9 are sufficient to define the species *C. mucronata*, in which they occur; and similarly *C. ensifera* is quite sufficiently defined by the spicules of figs. 10, 12, and 15. But to possess a complete knowledge of a species it is necessary to know more about it than its mere distinctive characters; one must know also the variations to which it is subject: a knowledge of the extreme as well as of the average characters of a species is of the highest importance if we would seek to construct accurate tables of phylogeny. Hence it has seemed to me well to add here figures and descriptions of the unusual forms of spicules which both the foregoing species exhibit—not that all of these will be available for immediate use, but that they may become so eventually, while some, on the other hand, will possess a present and special significance for us. The forms represented by Pl. II. figs. 18–21 are somewhat common variations amongst pin-head spicules: fig. 18 shows a form of doubly inflated head in which the second inflation is of a different size to the first; in fig. 21 the two inflations have become more nearly equal in size, but still remain in immediate contact with each other; in fig. 19 a still further change has taken place in the separation of the heads by an intervening portion of the cylindrical shaft. In fig. 20 the second inflation is merely lateral and confined to one side of the shaft.

In fig. 24 a short conical spine projects from the fusiform part of the shaft—a bud-like process, which, if prolonged, would give our uniaxial spicule a decidedly biaxial appearance. This budding of the spicules is one of the commonest of phenomena amongst the Spongidæ. In *Geodia arabica* I have seen a variety of one of the large anchoring spicules which had developed a fourth fluke, and so become four- instead of three-pronged; and, similarly, in a *Stelletta* I once observed a variety of the trifid bifurcate anchoring spicule in which an additional bifurcate arm had put in an appearance, so that the spicule had become quadrifid: thus, then, our uniaxial spicules may become biaxial, and, likewise, quadriradiate may become quinqueradiate spicules. The excessive variation to which sponge-spicules are subject makes it easy to conceive how the existing types of multiradiate spicules might have all originated from a primitive uniaxial cell. Let such uniaxial spicule-cells bud to a variable extent, some producing one, and others two, three, four buds and so on, and we should possess just the sort of material which, when submitted to the influence of natural selection, would furnish us with the spicules of all our existing types,—to me apparently a much more natural way of looking at things than that followed by Dr. W. Marshall. This speculative observer considers that, in the case of the Hexactinellidæ, a sarcodic meshwork was first produced, which afterwards became silicified, and then broke down into separate sexradiate spicules. We have, however, every reason to believe that sexradiate spicules originate, like all others, in spicule-cells; and Carter has actually seen the separate sexradiates of *Aphrocallistes* in various stages of cementation up to their complete enclosure in a continuous siliceous network. Marshall's view *, therefore, seems to me to reverse the case with a vengeance.

In fig. 23 we appear to have two spicules joined together by their heads, though whether by ankylosis or as a result of budding, one cannot, in the absence of a visible axial canal, definitely say. In fig. 16 we have two shafts diverging at an angle of 60° from the same head; and as but one head is seen here, the case is probably one of mere budding.

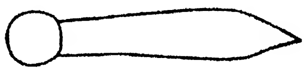
In fig. 24 the shaft of an ensiform spicule has lost its point and acquired a rounded termination like that of the mucronate spicules of *C. mucronata*, only without the mucrone; at the

* In reference to Marshall's conception of the structure of *Sclerothamnus*, I may here point out that, when spicules grow together by ankylosis, their axial canals do not become continuous by opening into one another; on the contrary, while two or more spicules may become one, their canals always remain separate and distinct.

same time it has become shorter; and in fig. 25 the diminution in length has gone a step further, while the shaft has become straight and cylindrical, so that, but for the absence of a terminal mucrone, it would almost exactly resemble the typical spicule of *C. mucronata.* In the last-mentioned species we have the spicule of fig. 4 showing a very considerable shortening in the long direction; in fig. 5 the spicule tapers from its wide neck, instead of enlarging from a constricted neck towards its rounded extremity. Fig. 2 appears to be intermediate between figs. 1 and 5.

These mucronate spicules are quite distinct from any form of spicule yet figured or described; and it is therefore exceedingly interesting to find varieties of them in which the mucrone is changing its character, and, by enlargement, tending towards the fusiform outline of *C. ensifera.* The instances in which this change is well marked were not discovered till after the plates were drawn; and so a single example is represented in the woodcut (fig. 1). Here, then, while *C. ensifera* shows spicules tending towards *C. mucronata*, *C. mucronata* on the other hand presents us with a variety of its staple spicule which almost passes into the staple spicule of *C. ensifera.*

Fig. 1.



Variety of mucronate spicule of *C. mucronata.* × 485.

But the difference between the other spicules of these two species, viz. the slender acuates (figs. 6, 12) and the flesh-spicules (figs. 9, 15), is so slight that no one would think of founding species on them alone. The main difference between *C. mucronata* and *C. ensifera* exists only in the form and size of the staple spicules (fig. 2, 11); and this distinction, as we have already indicated, is half or more than half bridged over by varietal modifications. It hence appears to me that in these two forms of *Cliona* we may actually witness, so to say, the transformation of species; for of the claims of each of the species we have described to distinction no one can for a moment doubt, while, at the same time, the forms by which one might pass into the other are also sufficiently obvious.

The flesh-spicules of both species are very interesting, as they appear to exist in all stages of growth. Their first appearance, so far as I can make out, is in the form of a simple straight rod about 0·0004 inch in length; this soon becomes sinuous and spined at each end with three or four conical spines; additional spines then appear along its sides, while by unequal lateral growth and by the unequal development of lateral spines the multicurved forms (figs. 15, 18) are

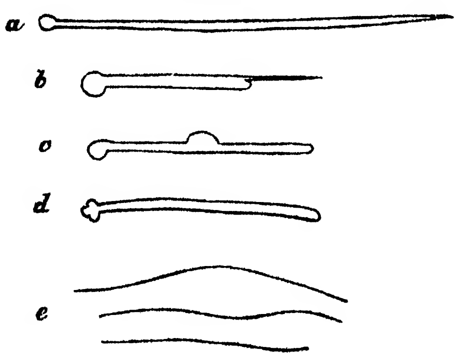
brought about. Fig. 19 represents a very unusual form, in which the spines of the spicule have become bifurcate at their ends.

Cliona subulata.

Associated with the *Isis* which furnished the preceding spicules, is a patch of *Melobesia*, in which also *Cliona*-burrows occur; but these, curiously enough, are occupied by a third species, the spicules of which are represented in Pl. II. figs. 26–28, and appear to belong to a new species, for which I propose the name of *C. subulata.* I should state that burrows of the two preceding species occur in the *Melobesia* along with this.

NOTE.—While writing this paper I had occasion to refer to a specimen of *Cliona* occupying burrows excavated in a solid piece of limestone rock, which I had brought away with me from Dawlish. I had always taken my specimen to be *C. celata*, and referred to it in order to determine whether it possessed diaphragms of any kind like those of *C. mucronata.* As to this my results were negative; but an examination of its spicules showed that it differed from *C. celata* in the form of its flesh-spicules, while its skeleton-spicules are essentially the

Fig. 2.



Spicules of *C. linearis*: *a*, skeleton-spicule; *b*, variety of *a*, with rounded end and produced spine; *c* and *d*, varieties of *a*, with rounded ends (*a*–*d* × 140); *e*, flesh-spicules (× 435).

same as those of *C. celata*, *Raphyrus Griffithsii*, and *Halichondria ficus*. The flesh-spicule, instead of remaining relatively short and becoming spined, attains, as if by the sacri-

fice of its spines, a great length (0·0033 inch) relative to its breadth, which is too small for measurement, and remains smooth.

This must be regarded as a variety of *C. celata*; and I propose for it the name of *C. linearis*.

Cliona linearis, var. of *C. celata*.

Skeleton-spicule as in *C. celata* (fig. 2, *a*). Flesh-spicule a long filiform acerate (fig. 2, *e*), straight or tricurved; length 0·0033 inch, breadth so narrow as scarcely to exhibit a double outline under a magnification of 500 diameters.

EXPLANATION OF THE PLATES.

Plate I.

Fig. 1. A fragment of *Isis*, sp., with *Cliona*-burrows: *m*, *m*, chambers of *C. mucronata*; *e*, *e'*, of *C. ensifera* (natural size).

Figs. 2–7. Outlines of chambers (A, B, C) of *C. mucronata*, showing various forms of diaphragms (a, b, c, d, d_1, d_2, d_4): d', diaphragm seen in plan, concealing an aperture beneath it; *w*, walls of a chamber. × 30.

Fig. 8. Hemispherical pittings on the walls of the *Cliona*-burrows. × 60.

Fig. 9. Imperforate conical form of diaphragm (*C mucronata*), seen from its convex or exterior surface. × 30.

Fig. 10. Tubular diaphragms (*C mucronata*): *f*, film of dried sarcode containing spicules; *l*, lumen. × 30.

Figs. 11–13. Diaphragms of *C. ensifera*: *f*, film of attached membrane; *c*, cells contained in the membrane. × 30.

Fig. 14. View of the edge of a diaphragm of *C. mucronata*. × 140.

Fig. 15. Superficial view of the inner surface of a diaphragm of *C. mucronata* mounted in Canada balsam. × 140.

Fig. 16. Openings in the walls of chambers of *Cliona* leading into tubular processes. × 30.

Fig. 17. Openings on the exterior of the *Cliona*-containing *Isis*, leading into the chambers of *C. mucronata* within: *p*, openings for pores; *o*, for oscules? × 30.

Fig. 18. Cells from the membranous films found in the chambers of *C. ensifera*: *b*, vacuole. × 435.

Plate II.

[All the figures on this Plate are magnified 435 diameters.]

Figs. 1–9. *Cliona mucronata.*

Figs. 1–3, mucronate spicules; figs. 4 and 5, varieties of the preceding; figs. 6 and 7, slender acuate spicules; fig. 8, variety of figs. 6 and 7, having two shafts, a short cylindrical one with rounded ends and a slender pointed one, both proceeding from the same head; fig. 9, various forms of flesh-spicules.

Figs. 10–25. *Cliona ensifera.*

Figs. 10, 11, and 22, normal ensiform spicules exhibiting different degrees of curvature.

Figs. 12, and 13, slender acuate spicules; fig. 14, a variety of figs. 12 and 13.
Fig. 15, flesh-spicules in various stages of growth, *a*, *b*, *c*, *d*, and *e*.
Figs. 16–25. Varieties of the ensiform spicule.
Fig. 16. Variety with two shafts diverging at an angle of about 90°, and proceeding from a common head.
Fig. 17. Variety in which the shaft has become straight and cylindrical and rounded at the end, so as to resemble mucronate forms of *C. mucronata*.
Figs. 18–21. Various forms of inflated terminations of the ensiform spicules.
Fig. 22. Extremely curved variety of ensiform spicule.
Fig. 23. Two ensiform spicules joined together, with an angle of divergence of about 150°.
g. 24. Variety with a conical spine.
g. 25. Variety similar to fig. 17.
s. 26–28. *Cliona subulata.*
s. 26 and 27. Skeleton-spicules of *Cliona subulata.*
g. 28. Flesh-spicule of same.

VIII.—*Description of a new Species of* Spatangidæ. By EDGAR A. SMITH, F.Z.S., Zoological Department, British Museum.

THE record of the existence of another species of the genus *Linthia* is very interesting, since up to the present time it comprised but a single recent form. Unfortunately I cannot give the locality whence the specimen was obtained with any degree of certainty; however, there is some evidence which tends to show that it was brought either from the Pacific Islands or from the west coast of South America, since it was found in a collection of shells which consisted almost exclusively of species which are well-known inhabitants of those regions.

Linthia rostrata.

Test, seen from above, cordiform, narrowed posteriorly, viewed laterally much beaked behind through the prominence of the hinder interambulacral region above the anus, and a deep well-marked excavation beneath the beak; lower surface a little convex; viewed endways the sides appear rather flat, converge to an obtuse apex, and gradually round off below, joining the somewhat convex base. Genital openings four, central, very small, equal, subequidistant; posterior pair scarcely wider apart than the anterior ones. Ambulacra very unequal, anterior lateral pair almost double as long as the posterior ones, moderately deeply sunken, inclined considerably towards the anterior end, yet arcuated in the opposite

direction; posterior petals equally deep as the anterior, a little narrower, very short, sinuous, diverging at their extremities; pores rather larger than in the recent type of the genus (*L. australis*), connected by a shallow groove; the narrow ridges separating them bear a few minute tubercles on their outer half. Peripetalous fasciole narrow, very angular and sinuous; in the posterior lateral interambulacrum it passes close to and almost parallel with the hinder furrows for about eight ninths of their length, then descends suddenly, forming an acute angle, and running close to the anterior lateral furrow, with two slight bends in its course, passes round the termination of the furrow in an abrupt curve, and rises in a straight line somewhat obliquely towards the anterior ambulacrum, where it suddenly descends at a right angle and parallel with the furrow, and then, after a short distance, a little above the ambitus, crosses in a curve the shallow groove. The lateral follows a similar course to that of *australis*. Anterior ambulacral groove almost as deep as the others, becoming gradually shallower towards the ambitus, with a series on each side of remote and very minute double pores, alternating with one another on each side, those just above the fasciole being about two millimetres apart. Tuberculation very like that of *L. australis*. Plastron narrowly cordate, convex, not much narrowed towards the mouth, and not reentering at the aboral end. Mouth broad, narrow. Anal opening ovate, acuminate above and below. The colour is that of cork, mottled with a darker hue in the middle of the plates.

Length nearly $1\frac{1}{2}$ inch, width at ambitus $1\frac{1}{8}$, height 1.

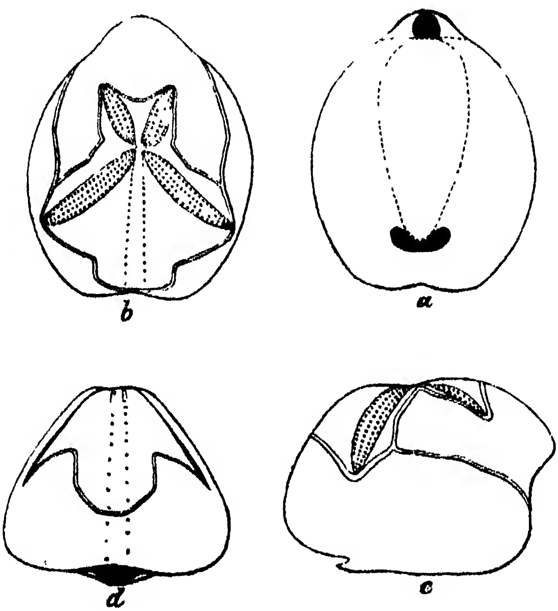
Hab. Pacific Islands (probably).

This species, of which I have only seen a single spineless specimen, has much of the general character of *L. australis* of Gray. Still there are so many differences, which, although perhaps small individually, in the aggregate become of much importance, that I certainly think they point out the specific distinctness of the form above described, and show that it passes the limits of an individual variation.

The position of the apex and genital pores is very different; the form is totally distinct, resembling very considerably that of the fossil *Micraster cor-anguinum*, var. *rostratus*; the proportion and inclination of the ambulacra and the course of the fasciole also show considerable variation. Besides these differences there are others—namely, the greater depth of the anterior ambulacrum and the remoteness and minuteness of the pores on each side of it; and in specimens of equal size of the old species the pores of the other ambulacra are

decidedly smaller and much more numerous, whilst the genital pores are larger. On the lower surface there are differences also: the plastron is conspicuously narrower and the oral aperture is considerably broader transversely.

The course of the peripetalous and lateral fascioles in *L. australis* is subject both to variation in different specimens and also to irregularity in the same individual. In normal specimens the first forms but a single angle some distance within in each interambulacral space; but in others, as is the case in the variety figured by Gray (Cat. Recent Echinida, 1855, pl. vi. fig. 2 *a*), it becomes biangular at its highest part both in the anterior and lateral interambulacra.



Linthia rostrata.

a, actinal view; *b*, abactinal; *c*, lateral; *d*, anterior.

The lateral fasciole in the same specimen is also irregular. On one side its position is normal; but on the other, from the point of contact with the peripetalous fasciole, it rises obliquely for the distance of nearly three quarters of an inch within the posterior lateral interambulacrum, then forming a sudden bend descends at right angles for half an inch, and, again bending less acutely, pursues the ordinary course, passing under the

anus in a broad curve. Exactly the same irregularity exists in another specimen; only in this instance it occurs on the opposite side of the test.

In other characters *L. australis* does not seem to be a species subject to much variation, judging from the specimens (fourteen in number) which I have seen. The form, direction, and length of the ambulacra and position of the vertex differ but very slightly in any of them; and this constancy of characters strengthens the supposition that the present, which offers such marked differences, is decidedly specifically distinct.

IX.—*On* Wagnerella, *a new Genus of Sponge nearly allied to the Physemaria of Ernst Häckel.* By C. MERESCHKOWSKY*.

[Plate VI.]

I HAVE just received the October number of the 'Annals and Magazine of Natural History,' which contains an article by Mr. Carter, entitled "Remarks on Professor E. Häckel's Observations on *Wyvillethomsonia Wallichii* and *Squamulina scopula.*"

M. Häckel, in his monograph on the Physemaria, has been very hard upon Mr. Carter, and reproaches him with having imperfectly observed the facts of which he speaks. Mr. Carter, in the article above mentioned, complains bitterly of the want of delicacy on the part of M. Häckel, and brings against him the same charges as to the want of exactitude which his works display, and their bad illustrations, which he regards as "more fitted for a caravan at a fair than for scientific purposes."

It is clear that impartial logic has taken leave of both writers in this matter, and that feeling interferes in the decision of the scientific question. In such cases it becomes more than ever necessary to stand exclusively upon facts, and to allow nothing but reason to say a word. Hence every new fact that may serve to throw light upon the question becomes very desirable.

My opinion is, that we must neither "laugh" nor "be angry," and that, instead, both sides must repeat their observations, criticise them better, and, taking into consideration all the facts acquired, bow to the power of truth, remembering that he alone never deceives himself who never thinks.

* This paper must be considered as a preliminary note of a memoir on White-Sea Sponges.

It is with the purpose of adding some new facts which may serve to elucidate the nature of the creatures in question that I have set myself at once to describe my observations made at the White Sea upon a new organism very nearly allied to the Physemaria of Häckel, and especially to *Haliphysema echinoides* = *Tisiphonia agariciformis*, but which, at the same time, must undoubtedly be placed among the sponges. I shall therefore pass at once to the description of this interesting creature.

In my first journey to the White Sea in 1876, I found in two localities*, upon the stems of *Sertulariæ*, a singular organism, which I met with again in 1877, in my last visit to this sea, so fertile in unknown and often very remarkable animals. This time I found it seated upon a branch of a Bryozoon, quite close to the islands of Solowetzky, at a depth of 2 fathoms.

At first, considering its small size (the sponge measures only about 0·5 millim.), I thought I had to do with some Rhizopod, such as the graceful *Clathrulina elegans* of Cienkowski for example, and the more as the form of this sponge, which consists of a spherical head placed upon a long and thin peduncle, very much resembles that of the above-mentioned freshwater organism. But closer acquaintance convinced me that the object in question was nothing but a very small sponge.

The entire sponge is composed of two very distinct parts—namely, a very long and very fine peduncle, and a round ball placed at one extremity of the peduncle, the other end serving to attach it to Hydroids or to Bryozoa. The peduncle itself is composed of two parts, one of which is a very long and fine cylinder, sometimes a little enlarged at its upper extremity where the ball is attached (Pl. VI. fig. 1). The approximate† width of this cylinder is 0·02 millim.; at its lower extremity it passes into the second part of the peduncle, which is nothing but a conical enlargement by means of the base of which the sponge is attached to foreign objects. This basal cone, as well as the cylinder, which is simply a prolongation of it, is composed of a very thin layer of organic material, probably consisting of syncytium, and of a great quantity of very small, rather stout spicules, which are placed horizontally in this organic layer, the whole forming together a fine although tolerably firm and elastic membrane, which serves as a wall

* Once between the islands of Solowetzky and the town of Kem, at 35° 25′ longitude, at a depth of 12 fathoms, on a stony bottom; a second time in the Bay of Onega, not far from Belogousicha, at a depth of 16 fathoms on stony ground.

† I shall give more exact measurements further on.

to the internal cavity of the sponge. This cavity passes without interruption through the whole body, from the basal cone all along the cylinder, to join the cavity of the globe, in such a manner that the whole organism presents us with a combination of a hollow cone with a hollow cylinder and a hollow globe. This great cavity, no doubt, corresponds to the gastral cavity of the other sponges, which would thus differ from *Wagnerella* (as I propose to name this sponge) only by their much thicker walls. The average length of the peduncle is 0·4 millim.; in most cases it is completely straight or very slightly curved: by force it may be bent at a right angle without breaking; but the moment the pressure ceases it returns again to its original rectilinear position. The head or globe is about 0·1 millim. in diameter, making only one fifth of the whole length of the animal. As I have already stated, the head is nothing but the direct continuation of the general cavity which passes through the peduncle, covered like it by a fine membrane. In fact, this head, as is shown by young individuals (Pl. VI. fig. 2), may be regarded as a dilatation of the peduncle at its extremity, which would render it analogous to the conical dilatation situated at the other extremity of the peduncle.

The most striking character of the head is the presence of long and excessively fine spicules (Pl. VI. fig. 5, *a–d*), which stand out all over the surface of the ball in a radiating manner, and give it a spiny aspect, like that of a sea-urchin. It is owing to these spicules that it is impossible to see distinctly the surface of the globe, and to determine whether there are or are not pores establishing a communication between the general cavity and the external water. The walls of the head are also furnished with small, short, and comparatively stout spicules (Pl. VI. fig. 6, *a–c*), only differing by their greater length from those which are implanted in the peduncle. Here, as in the peduncle, these fusiform spicules are implanted in the thin organic layer, so that their extremities do not project; but their position is not regular in the head, the spicules being arranged in all possible directions, although always in a position parallel to the surface.

As in all the Calcispongiæ, the spicules are composed of calcareous salts which dissolve in hydrochloric acid. Glycerine may also serve as a good reagent for determining the nature of the spicules without the necessity of destroying the specimen. On putting the animal, or merely a fragment of it, into glycerine, it is easy to see whether the contours of the spicules become more distinct than when seen in water or in alcohol.

If this is the case, we may be sure that we have to do with a calcareous body; on the contrary, when the contours gradually disappear and the spicules can hardly be perceived, we may conclude that they are siliceous.

The following are the comparative measurements of this sponge :—

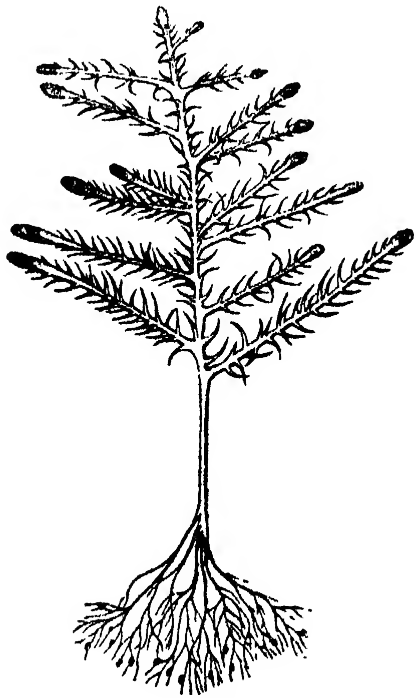
	millim.
Total length of the sponge	0·5–0·8
Diameter of the head in an adult individual ..	0·1012
" " a young individual ..	0·05885
Average thickness of the peduncle	0·018
Length of the large spicules of the head	0·01175–0·05875
Thickness (sometimes not measurable)........	0·00047–0·00117
Length of the small spicules	0·00064–0·01605*

It remains for me to explain the reasons which have led me to regard this animal as a sponge. It will be noticed that I have said nothing about pores, and this because I have found it impossible to find any. In spite of all my endeavours I have been unable to discover, either in the individual which I selected to study in the living state, or in those preserved in alcohol, any trace of pores; but it must not be forgotten that even if they existed, which is more than probable, it would be perfectly impossible to see them through the forest of innumerable spicules which cover the whole surface of the head and conceal its surface from the eyes of the observer. It must also be taken into consideration that the pores are not constant, and that the least irritation, especially the action of spirits of wine, is sufficient to close them, which would perfectly explain their absence. The same spicules coupled with the slight transparency of the head generally have also rendered it impossible for me to ascertain the existence of a buccal orifice at the extremity of the body, although I suppose such an orifice must exist from the analogy of what we see in the Physemaria.

But even if we admit that the existence of pores in *Wagnerella* is a fact unproved and even improbable, their absence cannot in any way lead us to doubt its spongiarian nature. In fact we are acquainted with several sponges the spicules of which have been described, but of which the pores, for different reasons, have not been discovered (see, for example, Bowerbank's monograph); and nevertheless we no not hesitate to admit that these are true sponges. Moreover we are acquainted with a marvellous sponge described by G. O. Sars in his interesting book 'On some remarkable Forms of Animal Life from the Great Deeps off the Norwegian Coast'

* The latter number refers to the head.

(1872). I refer to the *Cladorhiza abyssicola* of M. Sars. This sponge, which lives only at great depths, and which resembles rather a Hydroid or a Bryozoon than a sponge, has as a characteristic feature that the whole of it is entirely massive, absolutely without even traces of canals or of any cavity, and consequently without either buccal orifice or



Cladorhiza abyssicola, M. Sars*.

pores; and yet every one who reads M. Sars's description will be convinced that he has to do with a true sponge. In the White Sea also I have met with an *Esperia* (?) with long, filiform processes, like roots, which anastomose and form a network covering seaweeds and other bodies. Throughout their length, however, these are destitute not only of pores, but in general of canals or cavities, and are entirely composed of "syncytium" with spicules.

It is with the support of these facts that I cannot be of the

* Sars, 'On some Remarkable Forms of Animal Life, &c.,' pl. vi. fig. 17.

opinion of M. Häckel that in order to be a sponge an organism must have not only spicules but also pores.

With respect to the spicules of *Wagnerella*, we have seen (and I hope it is unnecessary to dwell upon this fact) that these spicules cannot by any means be regarded as foreign to the organism and borrowed from some other sponge (besides, the White Sea has no sponges furnished with spicules resembling those of *Wagnerella*), but that, on the contrary, we are led to the opinion that these spicules are produced by the sponge itself.

It is therefore evident that *Wagnerella* belongs to the Calcareous Sponges, and notably to the family Ascones. As regards the genus, I find that the system of M. Häckel, which is founded exclusively upon the spicules, is sometimes too artificial, and will become still more so in course of time. This system is founded principally upon the fact that the form of the sponge is a character too variable and inconstant to enable a system to be based upon it. Although in general terms this may be true, we nevertheless know, among the sponges, plenty of exceptions in which the form acquires so great a constancy that it may be employed not merely to characterize a species, but may even lead to the formation of distinct genera, as, for example, in the case of *Cladorhiza*. It is the same with our *Wagnerella*, of which the extreme smallness, the globular head supported by a long peduncle dilated into a cone at its base, are all constant characters, and consequently sufficient to bear one out in establishing a distinct genus. The few species of the genus *Ascyssa*, to which the animal might otherwise belong, are so little like *Wagnerella* that one would not hesitate in ordinary circumstances to form a separate genus for this organism.

M. Häckel, who has founded his genera upon different combinations of three kinds of spicules, has by this means restricted for ever the number of genera; for all the possible combinations have been employed by him; but it may be foreseen that Calcispongiæ will probably be found so different from the known forms, that it will be perfectly artificial to range them in one of M. Häckel's genera, and that, consequently, sooner or later it will be necessary to break through the boundaries laid down by him, and to found genera not only upon the combinations of the spicules, but also on their forms, the form of the body, and other characters.

I propose to name this genus, which has the habit of *Tisiphonia agariciformis*, and is furnished only with simple spicules, *Wagnerella*. The diagnosis of the genus and that of the species will be as follows:—

WAGNERELLA, gen. nov.

Sponges furnished with simple, long, calcareous spicules. Their body consists of a head or upper part, which is more or less globular, and of a long and slender peduncle which supports the former part, and at the opposite extremity is furnished with an enlargement of conical form, by means of which it adheres to foreign objects. Habit resembling that of the Physemaria (*Haliphysema*).

I give this sponge its generic name in honour of Professor Nicolas Wagner of St. Petersburg.

Wagnerella borealis, sp. nov.

Head regularly rounded into the form of a ball, placed on a very long and slender peduncle, the whole never exceeding 1 millim. in length (often 0·5 millim.). The cone of the peduncle as broad as high; the peduncle of uniform thickness throughout its whole length (sometimes a little wider above), nearly five times as long as the diameter of the head. All these parts (head, peduncle, and cone) have an interior cavity communicating freely throughout. The walls of the body are composed of a fine organic membrane, with spicules. The spicules are of two kinds: some long and excessively fine, tapering towards the two ends, adorning the head, in the surface of which they are implanted in a radiating fashion only by one end; the others shorter and stouter, fusiform, placed both in the head and the peduncle, entirely implanted in the organic layer without projecting from it at all, and all, without exception, arranged horizontally in the foot. No grains of sand or any other foreign objects adhering to the surface of the sponge. Length (average) of the long spicules 0·035 millim., of the shorter ones 0·01 millim.

Locality. White Sea, neighbourhood of the islands of Solowetzky, near the monastery (at a depth of 2 fathoms) and near Kem (at a depth of 7 fathoms).

Lastly, with regard to the two doubtful Physemaria, namely *Haliphysema echinoides* and *Gastrophysema scopula*, C., my opinion is as follows:—

Haliphysema echinoides.—When this is compared with *Wyvillethomsonia Wallichii*, Wright *, we see that we have to do with one organism, or, at any rate, with two varieties of a single organism, which, indeed, is admitted by M. Häckel himself. But if this be the case, it is perfectly evident that

* Quart. Journ. Microsc. Sc. 1870, vol. x. pl. ii.

we have nothing more than one sponge bearing the three names *Wyvillethomsonia Wallichii*, Wright, = *Dorvillia agariciformis*, Kent, = *Tiphisonia agariciformis*, Wyv. Thoms. Its spongiose nature may be further confirmed by comparing it with my *Wagnerella borealis*, to which it bears much resemblance and which is a true sponge.

With respect to *Gastrophysema scopula*, it is impossible to decide definitively whether it is a Physemarion or a Rhizopod. On the one hand, the presence of pseudopodia, which Mr. Carter has himself observed, leads us to believe in its Foraminiferous nature; on the other, its great resemblance to the other species of *Gastrophysema* observed by Häckel would make us think that both organisms belong to the Physemaria. In any case fresh observations upon *Squamulina scopula* can alone finally decide the question.

EXPLANATION OF PLATE VI.

[All the figures enlarged and drawn by the camera lucida.]

Fig. 1. An adult individual of average size of *Wagnerella borealis*. The peduncle is a little wider above, the head regularly rounded. There are more spicules than are here represented.

Fig. 2. A young individual with the head not yet round, and differing but little from the peduncle.

Fig. 3. Part of the peduncle, more highly magnified, with the small kind of spicules.

Fig. 4. Form sometimes presented by the basal cone of the peduncle, which, however, usually has the form shown in fig. 1.

Fig. 5. Different forms of the long spicules which adorn the head: *a*, immeasurably fine; *b*, stouter, but straight; *c*, long and curved; *d*, shorter and curved; *e*, zigzag.

Fig. 6. Different forms of spicules of the second category, fusiform, shorter and stouter: *a*, typical; *b*, curved; *c*, typical, with a bubble of air (?).

X.—*Descriptions of new Species of Heterocera from Japan.* —Part II. *Noctuites.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

Cymatophoridæ.

59. *Gonophora derasoides*, n. sp.

Nearly allied to *G. derasa*, but of a greyer tint; the markings (particularly on the white costal streak of primaries) less defined; the reniform and other discoidal spots narrower and more transverse; the area between the oblique white stripe and the zigzag lines pale stramineous, with darker and lunated

spots upon it, the zigzag lines wider apart, *only three in number*; the outer border white, the intersected semicircular marginal spots pale buff instead of ferruginous, the outer border of secondaries white, not yellowish. Expanse 1 inch 8 lines.

Hakodaté (*Whiteley*).

60. *Cymatophora ampliata*, n. sp.

Allied to *C. or*, but considerably larger, the primaries of a silvery grey instead of whity-brownish tint, the inner band darker, straighter, with more dentated limiting lines, the outer band with an additional angle towards the costa, and with the outer line more regularly undulated, blackish, and parallel to the inner line; fringe darker; secondaries darker; thorax greyer; head, collar, and antennæ testaceous. Expanse 2 inches.

Yokohama (*Jonas*).

61. *Cymatophora octogesima*, n. sp.

Allied to *C. ocularis*, but much larger, of a dark silvery grey tint, with the transverse lines and margins of the 80-like reniform and orbicular spots deep black, the lines near the base more dentated, the central band wider and its external limiting line irregularly zigzag; fringe of secondaries paler. Expanse 1 inch 11 lines.

Yokohama (*Jonas*).

Bombycoidæ.

62. *Acronycta leucocuspis*, n. sp.

Closely allied to *A. cuspis*, but the primaries of a darker grey tint, and the secondaries white instead of greyish brown, the discal line and external border darkest on the veins; thorax much darker; abdomen irrorated with black to the base. Expanse 1 inch 9 lines.

Var. Differing from the dark form of *A. cuspis* in the shining slaty grey tint of primaries, the spots upon which are only indicated by black annular markings, and in the paler greyish white colouring of the secondaries, on which the transverse discal line and outer border are easily distinguishable. Expanse 2 inches.

Yokohama (*Jonas*).

63. *Acronycta increta*, n. sp.

♂. Closely allied to *A. tridens*, but noticeably larger, the primaries much darker and shining, the fringe shorter, less

distinctly black-spotted; secondaries similar. Expanse 1 inch 10 lines.

Yokohama (*Jonas*).

Leucaniidæ.

64. *Mythimna placida*, n. sp.

Nearly allied to the North-American *M. pseudargyria*, but with the primaries and thorax pale sandy greyish, the orbicular and reniform spots less distinct, and the double discal series of black dots less complete; secondaries deep grey, blackish externally, with whitish fringe: primaries below blackish, with the costal and external borders whitish, crossed near the apex by a black dash; a marginal series of black dots; secondaries whitish, irrorated with black, a dot at the end of the cell, a discal series and a marginal series black; body below whitish. Expanse 1 inch 10 lines.

Yokohama (*Jonas*, *Pryer*).

65. *Mythimna rufipennis*, n. sp.

Allied to *M. turca*, but with barely an indication of the transverse lines on primaries, and with the secondaries and abdomen shining whity brown with rosy margin; below much paler than *M. turca*. Expanse 1 inch 6 lines.

Yokohama (*Jonas*).

66. *Mythimna grandis*, n. sp.

Allied to *M. turca*, but considerably larger; the male greyish, with the two transverse dusky stripes indistinct. In this species the inner stripe runs parallel to the outer as far as the middle of the discoidal cell, and then diverges abruptly inwards to the costal margin, the outer stripe is regularly denticulated: the under surface is whity brown, with a pink tinge; a dot at the end of each cell and a discal transverse stripe grey; a marginal row of black dots. Expanse ♂ 2 inches 1 line, ♀ 2 inches 4 lines.

♂ ♀, Hakodaté (*Whitely*); ♀, Yokohama (*Jonas*).

67. *Mythimna divergens*, n. sp.

Allied to the preceding, but darker, the reniform spot of primaries larger; the male brownish sericeous, or like the female; the female with a large central ochraceous nebula on the primaries, and an ill-defined red-brown patch immediately beyond the reniform spot; the inner transverse stripe of primaries slightly irregular, but diverging throughout from the

outer stripe; the reddish fringes of a deeper tint: the under surface deep dull reddish, the transverse line on the disk of the wings more slender, more continuous, and darker; the primaries with a dusky nebula just beyond the cell. Expanse, ♂ 2 inches 2 lines, ♀ 2 inches 3 lines.

♂ ♀, Hakodaté (*Whitely*).

68. *Leucania salebrosa*, n. sp.

Nearly allied to the North-American *L. insueta*, but smaller, the body more uniformly whitish, the collar with two transverse grey lines, the tegulæ longitudinally streaked with reddish and speckled with black; the white spot at the end of the cell in primaries more elongated: primaries below with the discoidal area greyish; secondaries below white, with a black dot at the end of the cell. Expanse 1 inch 3–4 lines.

Yokohama (*Jonas*).

Belongs to the *L. putrescens* group, but has grey dusky-bordered secondaries.

69. *Leucania singularis*, n. sp.

Primaries above sandy whitish, with two connected grey patches, one apical, the other filling the basal half of the median interspaces and emitting a streak along the median vein (somewhat as in the *L. putrescens* group), a silvery white spot at the inferior angle of the cell, and a black dot just inside the angle; two deeply crinkled divergent transverse grey lines dotted externally with black; a submarginal series of brown lunules, and a marginal series of black dots; fringe sericeous grey, tipped with white, and intersected by an indistinct dusky line; secondaries grey, with brown marginal spots; costal area and fringe whitish; body above sandy whitish: under surface white, primaries with a wide-spreading central greyish nebula, two whitish spots at the end of the cell, a dusky discal line and a series of black marginal dots; secondaries with a dot at the end of the cell, a discal series and a marginal series black. Expanse 1 inch 4–6 lines.

Yokohama (*Jonas*).

Unlike any species known to me.

70. *Leucania ærata*, n. sp.

Primaries above brassy brownish, a longitudinal streak along the median vein, and a subapical dash dark brown; a spot in the cell, a discal angulated series and a marginal series black; reniform spot pale yellowish; fringe greyish externally; secondaries white, with faint indications of a

discal series of dots and a submarginal streak dusky; a marginal series of black dots; thorax reddish brown, abdomen sordid whitish: wings below shining cream-colour; a black dot at the end of the cell, and a marginal series, largest and most continuous on primaries; the apical discoidal and disco-median areas of primaries and a streak near the external angle greyish; body whity brown, becoming darker towards the head; palpi and anterior coxæ smoky brown. Expanse 1 inch 7 lines.

Hakodaté (*Whitely*).

Nearest to *L. aureola*.

MICARDIA, nov. gen.

Allied to *Leucania*, but altogether less robust, the abdomen much more slender, the thorax less elevated, the palpi comparatively longer and more slender, the primaries broader, the style of coloration quite dissimilar. Type *M. argentata*.

71. *Micardia argentata*, n. sp.

Primaries sericeous whity brown with a tinge of olivaceous; a large silvery-white cuneiform patch, filling the greater part of the discoidal cell and extending a little below it; central area olivaceous, varied with rose-colour, bounded by an oblique white line, also an olivaceous streak from the latter to the apex; a submarginal whitish line and a marginal series of black dots; secondaries pale greyish brown, with dusky marginal dots and whitish fringe; body corresponding in colour with the wings, thorax crossed by a white belt: primaries below silky greyish, costal border sandy whitish, outer and inner borders silky creamy white; secondaries silky white; body below greyish. Expanse 1 inch 2–3 lines.

Yokohama (*Jonas*).

72. *Micardia pulchra*, n. sp.

Primaries whity brown, the whole central area and a discal streak (bounded internally by a white-bordered lilac streak, and externally by a submarginal white line) more or less tawny; a large subquadrate blackish patch bounded by the orbicular and reniform spots, which are lilac and white-edged; a large white-bordered elliptical spot of ochreous on the costa near apex; an interrupted black marginal line; fringe tipped with grey; secondaries silvery greyish, with an interrupted dusky marginal line and whitish fringe; body corresponding in general tint with the opposite wings: under surface shining

creamy white, primaries greyish in the centre. Expanse 1 inch 2–3 lines.

Yokohama (*Jonas*).

Mr. Moore has described a third species as *Leucania pulcherrima*.

73. *Alysia grisea*, n. sp.

♂. Above greyish brown, with a shining cupreous tinge; primaries with the external two fifths rather darker than the rest of the wing, the orbicular and reniform spots also rather darker, indications of an annular spot on a darker nebula near the base of the cell; costa spotted with darker colour; three white costal dots towards the apex; a patch of pale colour at the apex bounded on the costa by an elongated white spot; indications of a discal series of dusky-bordered semicircular pale spots; a series of black marginal lunules; fringe pale; secondaries much paler than primaries, with the exception of a broad external border; thorax darker than the abdomen; head and antennæ pale: under surface pale and shining, an irregular greyish disco-submarginal fascia; body below whity-brown, the pectus dusky in front. Expanse 2 inches 1 line.

Yokohama (*Jonas*).

This species somewhat resembles *Ochropleura flammatra*; but it is evidently a Leucaniid allied to the genus *Nonagria*, and apparently belonging to Guénée's genus *Alysia*, with which it agrees in the structure of the antennæ and palpi, neuration, and the width of the primaries.

Glottulidæ.

74. *Dandaca senex*, n. sp.

♂. Primaries above pale bluish grey, becoming greenish at base and on costal area, basal area crossed by an ill-defined sprinkling of raised white scales; a spot in the cell, the margins of the reniform spot (which is indicated by a black litura), a sigmoidal discal stripe, a subapical spot and zigzag submarginal line, all of raised white scales; a black irregular line across the basal area; two central slender black lines, the outer one deeply dentated, a ≻-shaped black marking and two spots near the external angle; costa black-spotted; fringe white, spotted with brownish; secondaries sericeous greyish brown, with a broad pale-edged blackish outer border, fringe pale, margin black-dotted; thorax greenish grey, abdomen sericeous whitish: wings below whity brown, with a broad black-edged irregular discal band; outer border broadly blackish; body below whitish. Expanse 1 inch 8 lines.

♀. Larger, darker; abdomen brown. Expanse 1 inch 10 lines.
Yokohama (*Jonas*).

Apamiidæ.

75. *Ochria fortis*, n. sp.

♀. Nearly allied to *O. flavago*, the primaries with the yellow areas considerably paler, the line interrupted by the reniform spot forming a semicircular arch; the orbicular and reniform spots much larger, the transverse subbasal brown belt greatly constricted below the median vein and darker; submarginal band, excepting at apex, suffused with brown and consequently indistinct; secondaries greyish brown, sordid whitish in the middle and at the base; thorax and head brown, collar stramineous, abdomen sordid whitish: wings below pale shining sandy brownish; the fringe and discocellulars of primaries, and two transverse streaks (the outer one of primaries diffused) dusky. Expanse 1 inch 10 lines.
Yokohama (*Jonas*).
In some respects more nearly allied to *O. cataphracta* of Grote.

76. *Gortyna acuminata*, n. sp.

Structure of *G. nitela* from North America. Above brown, shot with a faint lilacine gloss and clouded with grey; primaries with the costal margin and two diverging straight internally whitish-bordered transverse lines golden brown; basal area pale, bounded externally by a whitish line; outer border pale, with irregularly zigzag inner edge; orbicular and reniform spots greyish, bordered internally with whitish and golden brown; a marginal series of blackish lunules; fringe grey; secondaries with a broad triangular greyish patch from the middle of the cell to the abdominal margin, an ill-defined discal band of the same colour; costal area testaceous; palpi and antennæ burnt sienna; abdomen with the segmental margins, sides, and anus ochraceous: under surface reddish ochraceous, shining; primaries with an ill-defined darker discal streak. Expanse 1 inch 9–10 lines.
Yokohama (*Jonas*).
The primaries are acuminate and subfalcate.

Xylophasiidæ.

77. *Xylophasia sodalis*, n. sp.

Intermediate between *X. rurea* and *X. hepatica*, with the

pattern of the former, but the deeper coloration of the latter; it is, however, darker and more glossy than either, and the dark marginal spots of the primaries have a dull lilacine gloss; on the under surface the wings are not suffused with rose-colour as in *X. hepatica*, and the fringes are grey (dark in primaries), spotted with ochraceous nearly as in *X. rurea*. Expanse 1 inch 9 lines.

Yokohama (*Jonas*).

This species is also closely allied to *X. flavistigma* of Moore. The *Mamestra dubitans* of Walker, which I believe to be the dark form of *Xylophasia lignicolor*, bears a close resemblance to the *X. combusta* type of the above species; we have this variety both from Yokohama and Hakodaté. *Mamestra opposita* is the dark form of a Ceylonese species.

78. *Apamea conciliata*, n. sp.

Intermediate in colouring and pattern between *A. connexa* and *A. gemina*, with the form and general coloration of the latter, but with the irregular transverse band identical in shape with that of *A. connexa*, although much further from the outer margin and less oblique, the lower half of the band limited externally by an oblique white line, and followed by a whitish diffusion; apical area as in *A. gemina*, but without the pale spot at apex; secondaries as in *A. connexa*: wings below as in *A. gemina*, but darker, and with the dusky stripe across the secondaries nearer to the middle of the wing broadly convex (not 3-shaped); no dark spot at the end of the cell. Expanse 1 inch 6 lines.

Yokohama (*Jonas*).

The *Xylophasia indocilis* of Walker is the paler form of *A. gemina*; *X. libera* is identical with *Apamea finitima*, a species near *A. connexa*.

79. *Miana vulnerata*, n. sp.

Primaries greyish black, with the discal area brown; crossed by two very irregular black lines, widest apart on the costa and nearest just below the cell; two black >-shaped markings at the base; orbicular and reniform spots pale brown, enclosing an oval grey annulus and margined with black; an N-shaped band, testaceous, speckled with carmine, on the disk just outside the external black line; indications of a submarginal grey streak; a marginal series of black lituræ; fringe grey, intersected by a testaceous line; secondaries pale brown, with a marginal black line; fringe whitish, with a central grey line; body above greyish brown, abdomen whitish

at the sides: primaries below shining grey, the borders spotted with whitish; secondaries shining whitish; margin and a spot at the end of the cell black; two discal grey lines; fringe as above; body whitish. Expanse 1 inch.

Yokohama (*Jonas*).

80. *Miana segregata*, n. sp.

Primaries brown, crossed before the middle by a broad pale-edged darker band, its inner margin angulated and undulated, its outer margin nearly straight, but with a shallow sinus below the first median branch; a subquadrate costal sepia-brown white-edged spot near the apex, continued as an indistinct irregular band to the middle of the disk and enclosing a longitudinal black dash; a marginal series of black dots; an indistinct sigmoidal pale line near the base; fringe greyish, dusky below the middle; secondaries paler, with white costal margin, fringe partially white-tipped; body brown, whitish at the base of abdomen: primaries below greyish sericeous, internal area whitish, costal and external areas whity brown, speckled with darker brown; costa beyond the cell flecked with creamy-white; two indistinct parallel discal lines, the inner one angulated near the costa; secondaries whity brown, darker towards the apex, a dusky spot on discocellulars and an angulated discal line; body brown, pectus clothed with whitish hair. Expanse 1 inch 2 lines.

Yokohama (*Jonas*).

[To be continued.]

XI.—*Description of an apparently new Species of Hornbill from Cochin China, of the Genus* Anthracoceros. By D. G. Elliot, F.R.S.E. &c.

Anthracoceros fraterculus.

Male. Bill light yellow, with a black spot at base of mandible. A casque rises from base of culmen, extends backwards over the centre of the head, then curves forwards and returns to the culmen, at almost a right angle, at about one third its length from the tip of the maxilla. This is compressed laterally both at its anterior and posterior terminations, swelling outwards in the centre, but inclining to a keel-shape on top along its whole length. This casque is yellow like the bill, black on its anterior face, and with a broad black patch occupying nearly half the anterior portion, but which

does not reach to the maxilla. Naked skin around the eye and on sides of the throat flesh-colour. Head, neck, throat, upper part of breast, back, wing, and central tail-feathers black, with dark green reflections. Entire underparts, thighs, and tips of the secondaries and primaries pure white. Lateral tail-feathers have their apical third pure white, rest black, with green reflections. Tarsi and feet black. Total length from base of maxilla to end of central rectrices $23\frac{1}{2}$ inches; wing $10\frac{3}{4}$ inches; tail $11\frac{1}{4}$ inches; bill along gape $5\frac{1}{8}$ inches; casque on top $4\frac{7}{8}$ inches, height at base of maxilla $1\frac{1}{4}$ inch; height of bill and casque at base $2\frac{3}{4}$ inches; tarsus $1\frac{5}{8}$ inch.

Hab. Cochin China.

The present bird bears the same relationship to *A. malabaricus* as *A. convexus* does to *A. coronatus*, and apparently represents the *A. malabaricus* in Cochin China. It is much smaller than *A. malabaricus* in all its dimensions, has the casque much more compressed at the ends; and the black mark on the anterior portion *does not reach the maxilla*, but is confined to the casque as is seen in *A. coronatus*; whereas in *A. convexus* and *malabaricus* the black mark always extends onto the maxilla. The lateral rectrices, however, being only white for their apical third, indicates that the relationship of this species is with *A. malabaricus* and not with the others named. In order that the difference in size between the two species may be more clearly perceived, I add the measurements of *A. fraterculus*, as given above, and those of a fine adult male specimen, in the Paris Museum, of *A. malabaricus* for comparison:—

Anthracoceros fraterculus

From base of maxilla to end of rectrices $23\frac{1}{2}$ inches.
Wing $10\frac{3}{4}$
Tail $11\frac{1}{4}$.
Bill along gape $5\frac{1}{8}$.
Casque on top $4\frac{7}{8}$.
Height of casque at base of maxilla $1\frac{1}{4}$.
Height of bill and casque at base $2\frac{3}{4}$.
Tarsus $1\frac{5}{8}$.

Anthracoceros malabaricus.

From base of maxilla to end of rectrices 26 inches.
Wing 13.
Tail 13.
Bill along gape $6\frac{1}{4}$.
Casque on top $7\frac{1}{4}$.
Height of casque at base of maxilla 2.
Height of bill and casque at base $3\frac{3}{4}$.
Tarsus 2

The type was brought from Cochin China, and is now in the Paris Museum; and for the opportunity of describing it I am indebted to Prof. A. Milne-Edwards, who in the most liberal manner does every thing in his power to facilitate investigations in the magnificent collections under his charge.

It would appear, therefore, that there are four species of Hornbills belonging to the genus *Anthracoceros*, differing from

each other both in the shape and markings of their casques, and also in the distribution of the colours of the plumage. They can be distinguished as follows :—

Key to the Species.

A. Median pair of rectrices black, with green reflections.
- a'. Lateral rectrices pure white.
  - a''. Size large; black mark on casque never reaching the maxilla................ 1. *A. coronatus.*
  - b''. Size small; black mark on casque extending onto the maxilla................ 2. *A. convexus.*
- b'. Lateral rectrices with their apical third white.
  - a''. Size large; black mark on casque reaching onto the maxilla................ 3. *A. malabaricus.*
  - b''. Size small; black mark on casque not reaching the maxilla................ 4. *A. fraterculus.*

XII.—*On the Solitaire* (Didus solitarius, *Gm.*; Pezophaps solitaria, *Strkl.*). By Prof. R. Owen, C.B., F.R.S., &c.

[Plates VII. & VIII.]

Bones of this extinct bird collected in the island of Rodriguez during the "Transit-of-Venus" expedition, and now in the British Museum, have supplied materials for the articulation of the entire skeleton, and the subjects of the following notes.

In the skeleton of both male (Pl. VII. fig. 1) and female *Pezophaps*, the number of cervical vertebræ is 12, that of the dorsal 6, a 7th free-rib-bearing vertebra being made "sacral" by ankylosis with the rest of that coalesced group of bones.

So much of the vertebral formula thus accords with that of *Didunculus* *. As in that dove, also, the three middle dorsal vertebræ (third, fourth, and fifth) have coalesced, and their square truncate spines form a strong bony crest. Four pairs of ribs are connected, by ossified hæmapophyses, with the sternum; and this bone deviates mainly from the columbaceous type by the minor development of the keel, in relation to the atrophy of the chief muscles of flight.

Sixteen coalesced vertebræ constitute the sacrum of *Pezophaps* as of *Didus*; and seven free vertebræ beyond the pelvis support the tail-feathers. Thus the vertebral formula of *Pezophaps* is :—

C. 12, D. 6, S. 16, Cd. 7,=41.

* See the figure of the skeleton of the didiform species of the Samoan Isles in my 'Memoir on the Dodo,' 4to, 1866, pl. iii. fig. 2.

There is one free-rib-bearing vertebra less, and one sternal rib less, than in *Didus*; and this difference accords with the proportional larger trunk of the heavier Ground-Dove of the Mauritian Island.

In the atlas and third vertebra the interzygapophysial bar, with the foramen it defines, is present *. The neural spine subsides to a pair of tuberosities in the fifth cervical; and this bifid condition is traceable to the ninth, where each division degenerates to the beginning of a ridge leading to the hyperapophysis. This process †, conspicuous and large on the axis and third vertebra, subsides in the following, but rises from its rudimental state in the ninth and following cervicals.

The protuberance from the under part of the par-pleurapophysis of the fifth and sixth cervicals shows as the "catapophysis" of Mivart in the seventh; and, each converging towards its fellow, the pair of inferior processes become distinct in the ninth, approximate in the eleventh, and blend into the single median hypapophysis in the twelfth cervical vertebra. This process increases in vertical and fore-and-aft extent to the middle of the three coalesced dorsals, and almost disappears in the hindmost (fifth dorsal); it is similarly represented as a low median ridge in the last free dorsal (sixth).

The sternum of *Pezophaps*, as of *Didus*, accords with the diduneuline modification of the Dove's breast-bone, in the breadth, for example, of the ectolateral processes and the absence of entolateral ones. The median hinder end of the sternum is narrower, more "xiphoid" in character, than in *Didunculus*. The four articular ridges and depressions in each costal border are close-set, especially the third and fourth.

The costal process is both broad and thick, presenting a trihedral subconcave facet towards the ribs. The thin ectolateral plate overlaps the two hinder hæmapophyses joining the sternum. The median pneumatic fossa at the anterior part of the sternal concavity communicates by a canal with the convex or outer surface. The convex contour of the sternal keel is due to the suppression of the anterior subangular extension which is present in the volant Dodlet.

The first and obvious character in which the great extinct Ground-Doves differ from the smaller existing volant kinds is in the small proportion of the brain-case to the rest of the skull. If the length of the cranium be taken from the back of the occiput to the front of the frontal bone, it is, in *Pezo-*

* "On *Dinornis*.—Pt. XXI.," Trans. Zool. Soc. vol. x. p. 152, fig. 11, *r*, *s*, third cervical of *D. maximus*.

† *Ibid* p. 151, fig. 4, *hp*.

phaps, rather more than half that of the skull; in *Didus* it is little more than one third.

The difference is not due to the small relative size of the orbits, but to the great relative length of the beak, especially of the narial part, in *Didus*. This part, which includes the lateral bony external nostrils, is relatively shorter in *Pezophaps* than in *Didus*.

The interorbital septum is entire in both genera.

In both *Didus* and *Pezophaps* the upper grooved border of the foramen magnum extends further back than the condyle. The occiput, in *Pezophaps* (Pl. VII. fig. 2), is vertical, feebly convex vertically and transversely, divided by a pair of arched insertional depressions from the rugose, somewhat overhanging hind tract of the parietal region (ib. 7). The temporal fossa is larger, relatively and absolutely, in *Pezophaps* than in *Didus*; it resembles that of *Treron*. The elevation of the frontal region is due, in *Pezophaps*, as in *Didus* and *Treron*, to excess of bony cellular diploë, and takes place in advance of the orbits in all Columbidæ. The interorbital tract of the cranium (Pl. VIII. fig. 1, 11) rises from the præmaxillo-nasal platform (ib. 15, 22) more abruptly in *Pezophaps* than in *Didus*; but it sooner subsides, and the fronto-parietal tract, or vertex, is flatter. This tract is smooth, but surrounded by a broad rugose elevated border, continued from the superorbital ridge backward over the temporal fossa, then across the postparietal region (ib. 7) to meet the ridge on the opposite side. The superorbital tracts converge forward to form the frontal convexity. This, however, is mesially cleft, exposing a deeper-seated smooth tract, over which a bony fringe projects on each side. This structure exists in a minor degree in the female. The superorbital tract is more rugose in the male than in the female *Pezophaps*.

The chief difference between *Didus* and *Pezophaps* in cranial structure is the degree in which the cancellous tissue is developed between the outer and inner "tables," the minor quantity of that tissue in *Pezophaps* causing less elevation and convexity of the frontals above the orbits as compared with that part of the cranium in *Didus*.

The lacrymal, coalesced with the prefrontal part of the frontal, curves down and back in front of the orbit; it is impressed by a deep, wide, smooth longitudinal channel externally, conducting the duct to the naso-lacrymal orifice anterior to the orbit.

To view the neurapophyses of the nasal vertebra, the nasals, premaxillary, and coalesced part of the frontals must be

removed; and then the homologue of the "os en ceinture" of batrachotomy and of the "æthmoid" of anthropotomy is brought into view, with part of the confluent olfactory capsules.

The essential elements of the anterior terminal segment have undergone extreme modification and travelled far from the almost typical condition which they present in most fishes*.

In the bird strong processes answering to diapophyses are extended outwards from the neurapophysial or essential parts of the prefrontals; and to these the name "prefrontal" is restricted by some who retain the term "æthmoid" for the plates transmitting the olfactory nerves from the rhinencephalon. In *Macropus* and most other marsupials the corresponding extension is grooved longitudinally, as in *Didus* and *Pezophaps*; but the fissure transmitting to the nose the lacrymal duct, anterior to the grooved lacrymal bone, in the bird, is reduced to a fossa with one or two foramina in the implacental mammal.

The maxillary sends up a strong nasal process confluent with the outer branch(15′) of that bone, which articulates with the swollen fore part of the frontal, outside the base of the inner division (15) of the nasal bone. The common coalesced bases of the nasals and nasal process of the premaxillary rise as a transverse bar (Pl. VIII. fig. 1, x), with a convex anterior border, above the rostral divisions of those bones; in this character *Pezophaps* resembles *Treron* and *Didunculus*; while in *Didus* the premaxillary and nasal portions of the elevated basal tract are indicated by grooves therein. In both genera, as in recent doves, 15 and 22′ are confluent with 11. Beyond the confluence the divisions of the nasal pair are separated by the nasal process of the premaxillary (22′). The inner division or normal part of the nasal is 1 inch 8 lines in length; it extends forward for half that length along the outside of the premaxillary, then inclines mesiad beneath that bone, coming into contact with its fellow for six lines extent of their terminal pointed end; they underprop the nasal process of the premaxillary; and thus we have, in the extreme variation of an extreme segment of the vertebral axis, the hæmal spine closing the tubular series by overlapping the neural spine of its own segment. The under surface of the nasal process of the premaxillary is impressed by the shallow channel receiving the underpropping fore part of the midnasals.

The basi-presphenoid (Pl. VIII. fig. 2, 5, 9) is 2 inches long in the male; it has no pterapophyses.

* See, *e. g.*, the prefrontals of *Xiphias* in my 'Archetype of the Vertebrate Skeleton,' pl. i. fig. 5, 14.

There is, as is well-known, no "maxillo-palatine or pre-vomerine bone" in the bird's skull distinct from the proper maxillary or proper palatine. The latter bone (ib. ib. 20) speedily coalesces with the premaxillary (22) in front, and the maxillary (21′) above, as does this with the premaxillary in front and with the malar bone behind. Their respective limits are definable by their unconfluent condition in the immature bird.

In *Pezophaps* the persistent linear suture between the palatal part of the maxillary and the palatine commences 1 inch 10 lines from the tip of the beak; it defines a linear tract of the maxillary of 1 inch 3 lines extent. External to this suture is the palatine tract, coalesced with the maxillary, in breadth 2 lines, in length 10 lines; when the palatine becomes free, it is twisted on itself, forms a vertical plate of 3 to 4 lines depth, and sends off from the median side, of a hinder extent of 7 lines, the horizontal plate, which bends mesiad. Between these right and left median plates of the palatines is an interval of 2½ lines. The interpalatine vacuity in advance of the horizontal plates is 4½ lines across. The upper parts of the hinder five lines of the palatines are applied to the convex sides of the presphenoids. The pterygoids (24) abut against the basisphenoid immediately behind the palatines, each pterygoid diverging and expanding to abut against the tympanic. The maxillo-palatal cleft is long and of moderate and uniform width; the interpalatal cleft is wider until the inner plates are developed.

The beak of the bird serves as both hand and mouth; the apex of the wedge, in these functions, is driven against resisting bodies sometimes of considerable hardness. In all birds the opening and closing of the bill are acts of prehension. In many birds these latter movements are not limited to the lower jaw, but a mechanism exists for raising the upper jaw as well. The joint between the base of the bill and the cranium is made flexible by diverse modifications. The tympanic is fashioned in relation therewith. It is connected by two beams or columns of bone on each side of the skull with the fore part of the upper jaw. The outer beam, commencing forward at the side of the maxillary, is continued by the malo-squamosal style to the outer side of the transversely expanded lower part of the tympanic. The inner beam, commencing by the palatal process of the premaxillary, is continued backward by the palatine and pterygoid bones to the inner side of the lower end of the tympanic. Any swinging to and fro of this bone upon its single or double upper ball-and-socket joint is transferred to the "core" by the four beams converging

thereto. The action of the outer beam upon the maxillary is conjoined with that of the lower beam upon the premaxillary by the overlapping broad palatal plate of the maxillary, which is more or less confluent with the palatine and premaxillary bones beneath.

The movements of the mandibular part of the bill are transferred by the long bar-like rami of the lower jaw to the lower end of the tympanic, with which those rami are movably articulated by a combined double ball-and-socket and also trochlear articulation.

When the tympanics are swung forward they communicate that motion by their six converging bony bars to the upper and lower cores, raising the former, depressing the latter—in short, opening the mouth. When the tympanics swing backward, opposite movements are transferred forward by the connecting bars, and the beak is shut.

But when in this state it is used (as by the Woodpecker) as a pick or wedge, the strength of the blow transferred backwards by the three divergent pairs of bars is met, not by a rigid basis, which might have involved fracture of those bars or of some of them, but by a yielding one, as in the butts with elastic buffers terminating a railway line, for arresting and receiving the shock of a train.

The beak as a whole, and especially its outward and visible portions, have suggested to ornithologists characters of groups with good and accepted descriptive terms; the modifications of a part of the mechanism, a single beam, seem inadequate to sustain a new nomenclature.

The basisphenoid (Pl. VIII. fig. 2, 5) in advance of the ridge or process which underhangs the bony outlets of the Eustachian tubes loses breadth and seems narrowest where impressed by the abutting ends of the pterygoids (24).

The postarticular end of the mandible of *Didus* differs from that in most Columbidæ in not being abruptly truncated, but produced in the form of a short right, or rather open, angle with the apex obtuse*. That of *Pezophaps* (Pl. VII. fig. 1) is more columbaceous; it is produced a short way behind the articulation, and is vertically truncate, without loss of depth. It agrees in this respect with *Didunculus*.

There is nothing extraordinary in the conformation of the pelvis of *Pezophaps*. The acetabulum is situated in the anterior half, as in *Didus*. The ischium (Pl. VII. 63) coalesces with the ilium (62) at two points, circumscribing a moderate

* 'Dodo and its Kindred,' pl. viii.; 'Memoir on the Dodo,' pl. i.

subelliptic "foramen ischiadicum" (*h*) as in *Didus*. The pubis (64) does not send upward a process to meet the downward one from the ischium, and so define the "tendinal" (*o'*) from the "obturator" (*o*) interspace.

The pelvis in the male skeleton shows the whole extent of the entire lower border of the ischium; and its slender hinder termination is produced into contact with the pubis (64), from which bone a rough low tuberosity rises to form the syndesmosis with the ischium (63). On the left side the extremity of the ischium is broken off; but the syndesmotic process of the pubis testifies to an original union like that on the right side.

Here, therefore, we have an acceptable proof of an osteological correspondence with existing doves, which the imperfect examples of the pelvis previously acquired did not exhibit.

The scapula of *Pezophaps* repeats, in a minor degree, the angular beginning of the hinder thin border above the elongate neck of the bone, but projects less as a process than in *Didus* *; the distal or free end expands as in *Didus*. The straightness of the bone is more marked than in *Didus*.

The metacarpus of the male (Pl. VII. fig. 1, II.) repeats the tuberous process figured by Prof. Newton in pl. xix. figs. 87–90 of his richly illustrated memoir †, and testifies, as he shows, to the value of Leguat's record, and to the accuracy of that original observer of the living bird.

If a single specimen of a metacarpal bone of some unknown animal, such as is figured in Pl. VII. fig. 1, II., had previously come to the hands of a palæontologist, he would have concluded the bony tumour to have been of morbid nature and origin, and set it down as an exceptional pathological phenomenon. Any other opinion (above all, one holding such tumour to be a constant structure, functional in the healthy individual, and of moment in guiding to a knowledge of the species or sex) would have hazarded the estimate of such palæonlogist's standing in his science.

In the rich collection of bones of *Pezophaps*, the subject of Prof. Newton's instructive paper (*tom. cit.*), there were not fewer than thirty-two specimens of the metacarpus. "That it would be very short was a safe inference from what we know of it in other flightless birds; but it could hardly have been expected to obtain from it such a singular confirmation of Leguat's statement regarding a remarkable peculiarity in the

* 'Memoir on the Dodo,' *ut suprà*, pl. viii. figs. 6, 9, 51.
† Phil. Trans. 1869.

'Solitaire' as observed by him, nor that it should furnish an explanation of the curious bony growth on the distal end of the ulna and radius already mentioned as presented by the specimens of supposed males. All the perfect specimens of the metacarpal have on the radial side a more or less spherical bony knob or callus-like mass developed immediately beyond the proximal end and the pollex. . . . The appearance of the knob is much that of diseased bone; it has probably been covered by a cartilaginous integument" (ib. p. 342). The author then repeats the quotation given by Strickland in his excellent work:—"L'os de l'aileron grossit à l'extrémité, & forme sous la plume une petite masse ronde comme une balle de mousquet: cela & le bec sont la principale défense de cet oiseau"*.

The specimens of metacarpus of the larger, combative sex of *Pezophaps* in the British Museum show the same structure, which may be seen in the articulated skeleton of the, probably, male Solitaire now there exhibited (Pl. VII. fig. 1, II.).

This hard, irregular, prominent mass, which holds the place of the spine in the Spur-winged Goose, may be compared to a "knuckle-duster;" with it the combative sex delivered his blows, in the hard and well-contested fights to which Leguat testifies:—"Ils ne volent point, leurs ailes sont trop petites pour soutenir le poids de leurs corps. Ils ne s'en servent que pour se battre, & pour faire le moulinet, quand ils veulent s'appeller l'un l'autre."

I here infer the writer to mean that one function of their stunted wing was to do battle with each other; and the peculiar development in question I take to have been the combative weapon. The entire wings were in action in executing the amorous pirouettes:—"Ils font avec vitesse vingt ou trente pirouëttes tout de suite, du même côté, pendant l'espace de quatre ou cinq minutes."

Of the bones of the hind limbs, the greater relative length of both femur, tibia, and metatarsus, as compared with the skull and sternum, is first notable in *Pezophaps* in contrast with *Didus*.

The columbine characters of the metatarsus are manifested in both species. These characters in *Pezophaps* are recorded in Trans. Zool. Soc. vol. vii. pl. lxvi., and are repeated in that bone of the subject of Plate VII.

The following are admeasurements of the skeleton of the two extinct species of Ground-Doves:—

* Strickland, 'The Dodo and its Kindred,' 4to, 1848, quoting the 'Voyage et Avantures de François Leguat,' 2 vols. 12mo, 2nd ed. 1720, vol i p. 98

		Pezophaps solitaria. ft. in. lin.			*Didus ineptus.* ft. in. lin.		
Length of vertebral axis, from tip of beak to end of coccyx, following the curves	*Mas.*	2	11	0	3	2	0
Length of vertebral axis, from tip of beak to end of coccyx, following the curves	*Fem.*	2	7	0			
Height in easy standing position	*Mas.*	2	7	0	2	0	0
Height in easy standing position	*Fem.*	2	2	0			
Length of leg, from proximal end of tibia to sole	*Mas.*	1	4	6	1	2	0
Length of leg, from proximal end of tibia to sole	*Fem.*	1	1	0			

The Solitaires were found living in great numbers by the colony of Huguenots who settled in the island of Rodriguez, under their leader M. François Leguat, in 1691.

Pezophaps, according to the testimony of Leguat, laid but one egg at the breeding-season; and the same was probably the case with *Didus*, as it is with the existing species of fruit-eating doves (*Carpophaga*) and the passenger pigeons (*Ectopistes*).

The Moas appear to have been similarly restricted, as their living representatives, the Kivis, also are, in the number of the eggs of each brood.

The condition of the existence of *Pezophaps*, and probably that of its flightless structure, was the absence of any extirpating enemy in the island to which the species was restricted. Feeding on the date, the plantain, and other tropical products of a rich vegetation encumbering the soil when ripe and fallen, their flesh was sapid as well as nutritious; and the early Huguenot colonists commenced the work of extirpation, which their successors and the quadrupeds (cats and pigs) which they introduced completed.

In assigning the origin of the species *Pezophaps solitaria* to the operation of a primary law, by way of direct creation of a primitive pair, the osseous tumour on the wrist of the male, and the fore pair of limbs in both sexes, framed on a pattern fitting them to exercise the faculty of flight and for no other kind of locomotion on land, but of too small a size for that end, are among the incidents of this "thaumatogeny," or inconceivable mode of genesis.

The other alternative is a reference of the species to the operation of a secondary law, by no means implying disbelief in, or involving denial of, the Lawgiver. In speculating on the mode of operation of such law, the following facts present themselves:—

Pezophaps solitaria was the largest kind of land bird observed by the first settlers in the island of Rodriguez.

It differed in no other respect from the class-characters of the other birds of that island save in the inability to fly by the action of its wings.

There were no enemies native to the island able to take advantage of that disablement.

"Il ne s'y trouve aucune animal à quatre pieds, que des rats, des lézards, & des tortues de terre, desquelles y a trois différents espèces," writes Leguat in his interesting little book *.

The Solitaires had no call for practising or endeavouring to effect that hardest and most strenuous mode of locomotion to obtain sustenance or fulfil any of the conditions of preservation of the individual or of the species; they were never scared into such violent exercise.

Upon these facts I found a conclusion as to how the specific character of wings, useless as such, came to be; and this conclusion as to *Pezophaps solitaria* is the same which I have set forth more at length in relation to *Didus ineptus* †, and which I deem to be applicable to the still larger terrestrial birds discovered, as in the case of *Æpyornis*, *Dinornis*, *Aptornis*, *Notornis*, *Cnemiornis*, in similar geographical and associated zoological conditions—these birds, like the Dodo and Solitaire, having become extirpated through alterations of the latter conditions, *i. e.* by introduction of species new to their island-homes, and with dispositions and powers destructive of such flightless birds. Thus is illustrated the origin of species by a condition of the way of work of a secondary law suggested by Lamarck.

Two alternative hypotheses have been propounded. One by Mr. Darwin, is discussed and conjecturally exemplified by the authors of the paper "On the Osteology of the Solitaire" (*loc. cit.* pp. 49–51). The other hypothesis assumes that the *Iguanodon*, *Megalosaurus*, *Scelidosaurus*, and other Dinosaurian reptiles walked on the hind pair of legs, like birds, and initiated that class by becoming transmuted into the warm-blooded, feathered, but wingless species. No suggestion has

* Voyage et Avantures de François Leguat, & de ses Compagnons, en deux isles désertes des Indes Orientales. Avec la relation des choses les plus remarquables qu'ils ont observées dans l'Isle Maurice, à Batavia, au Cap de Bonne-Espérance, dans l'Isle St.-Hélène, & en d'autres endroits de leur Route. Le tout enriché de Cartes & de Figures. Tome Premier & Tome Second (12mo). A Londres, chez David Mortier, Marchand Libraire. 1708.

† 'Memoir on the Dodo,' 4to, 1866, pp. 49–51.

been made by the author or acceptors of this hypothesis as to the way of operation or conditions of the transmutation.

In most of the instances of wingless birds affinity to more favoured or normal members of the feathered class has been traced.

The Penguins (*Impennes*) cannot be dissociated from the smaller *Urinatores*, which retain the volant function of the wings.

Alca impennis is not generically separable, in judicious taxonomy, from the swiftly flying *Alca torda*.

The genera *Aptornis* and *Notornis*, with keelless breast-bones, cannot be divorced from the family of Coots.

Cnemiornis, although also with a "ratite" or uncarinate sternum, must stand, besides *Cereopsis*, in the Anserine group of Anatidæ.

The Didines are but generic modifications of a great natural division of Rasores, the existing members of which, of smaller size, retain their faculty of flight.

Dinornis shows the consequence of disuse of wings in a greater degree than does *Apteryx*. But, although the winged forms from which the Kiwi, the Cassowary, the Emu, the Rhea, the Ostrich, and the *Æpyornis* have severally degenerated remain to be determined, they each have structural characteristics encouraging the quest, and testifying against the artificial group (*Megistanes*, Vieillot; *Proceri*, Illiger; *Ratitæ*, Merrem; *Struthionidæ*, Vigors) based upon modifications of the breast-bone and scapular arch, the consequences of disuse and degeneration of the muscles of flight, and with which a loose character of plumage is more or less associated.

The results of the researches which have determined the real affinities of extinct birds with keelless breast-bones and low-angled scapulo-coracoids, devoid of acromial and clavicular processes, supports a reasonable expectation that the existing wingless genera, which have been shown to differ from one another considerably in important anatomical structures, in correlation with their distinct and remote habitats, will be ultimately referred to as many distinct natural groups which now are, or which formerly have been, represented by volant and typical members of the feathered class.

EXPLANATION OF THE PLATES.

Plate VII.

Fig. 1. Reduced side view of the skeleton of the male Solitaire.
Fig. 2. Occipital surface of cranium, natural size.
Fig. 3. Copy of a figure of the living Solitaire, from the frontispiece to Leguat's work, above cited.

PLATE VIII.

Fig. 1. Top view of the skull of the male Solitaire.
Fig. 2. Under view of the skull of the female Solitaire.
Both figures are of the natural size.

XIII.—*Description of a new Species of Water-bird from Cochin China belonging to the Genus* Porphyrio. By D. G. ELLIOT, F.R.S.E. &c.

Porphyrio Edwardsi.

Adult. Ear-coverts, lores, and round the eyes greyish white. Back of head brown, darkest in the centre, where it is almost a brownish black with a purple tinge, shading off to a greyish white towards the frontal plate and the sides of the head. Cheeks bluish white. Chin and throat brownish, with a bluish shade. Back and sides of neck, lower part of breast, and flanks dark violet-blue. Front of neck and upper part of breast, shoulders, and under wing-coverts deep turquoise-blue. Back, rump, wings, secondaries, primaries, and tail uniform greenish black. Middle of abdomen and crissum brownish black. Under tail-coverts pure white. Bill, frontal plate, legs, and feet apparently bright red. Total length $16\frac{1}{4}$ inches, wing $10\frac{3}{4}$, tail $4\frac{1}{4}$, bill along gape $1\frac{1}{4}$, width of frontal plate at posterior margin $\frac{7}{8}$, tarsus $3\frac{3}{8}$, middle toe $3\frac{3}{4}$, claw $\frac{3}{4}$.

Young. Top and back of head covered with downy black feathers; sides of head grey; chin and throat white; breast dark turquoise-blue, flanks and abdomen violet-blue. Crissum and thighs brownish black, streaked in certain places with white. Wings and back greenish black. Rump brownish black. Bill red, with the culmen and lengthened spots on the mandibles near the commissure black. Frontal plate small, apparently red. Legs and feet pale red. Total length $10\frac{1}{4}$ inches, tarsus $2\frac{3}{4}$, bill at gape 1.

Hab. Cochin China; Saigon (*Germain*); Bangkok (*Bocourt*).

Four specimens of this fine species are in the collection of the Paris Museum, three adults and one young bird, obtained in different localities in Cochin China. It has probably been confounded with the *P. poliocephalus*, Lath., of India, which it resembles in certain portions of its plumage. The present species differs in being darker on the back of the head, in having the blue of the breast of a darker shade, and especially in having the upper parts, including the entire wings, greenish black, instead of the purple back and rump and pale greenish blue wings of *P. poliocephalus*. This colouring of the upper

parts is so conspicuously different in the two species, that either one can be recognized at a glance. Two of the adult specimens are precisely alike; the third is a little paler upon the sides of the head; but all possess the uniform greenish black back and wings.

It gives me great pleasure to bestow upon so handsome a bird the name of my friend Professor Alphonse Milne-Edwards, so well and favourably known for his many and highly important contributions to natural science, and who, in the kindest manner, has placed at my disposal all the specimens of this genus contained in the collection of the museum to assist me in my investigation of the group.

BIBLIOGRAPHICAL NOTICE.

The American Palæozoic Fossils, &c. By S. A. Miller. Large 8vo. Pp. 253. Published by the Author Cincinnati, U. S., 1877.

This work consists of a catalogue of the genera and species of Palæozoic Fossils found in North America, giving the names of authors, dates, places of publication, groups of rocks in which the fossils occur, and the etymology and signification of the words, together with a preliminary discourse, by Prof. E. W. Claypole, on the construction of systematic names in palæontology, and an Introduction by the author, on the stratigraphical geology of the American Palæozoic rocks.

This, we believe, is the latest of many useful catalogues of fossils prepared by geologists of different countries, and devoted to the consideration of either particular groups or the world-wide distribution of organic remains. In this case the fossils treated of are limited to those of the Palæozoic Rocks of North America, and form an extensive list of at least 1000 genera and 8000 species, besides very many names (upwards of 2000) which are either synonyms or not well determined.

The organic remains here enumerated are grouped according to their Orders, the Families of which are mentioned for each division.

A special feature in this work is a most praiseworthy attempt to produce the names with correct etymology and derivation. But besides those errors mentioned in the lists of *corrigenda* at pages 64 and 246, there are many that have escaped the author's notice; and some of them go to prove how true his observation is that the mistake of the original name of a species is perpetuated in successive transcripts; whilst others show, as usual, the difficulty found by any one in trying to express himself in a language unknown to him.

Prof. Claypole, both in his excellent essay on nomenclature and in revising a great portion of the Catalogue, has evidently worked

hard to improve the orthography of the palæontologists; and he well observes that the unfamiliarity of many with Latin and Greek, the carelessness of some who know better, and the misprints in press have been, and still are, powerful agents in making and keeping errors in scientific nomenclature. In some of the classes of fossils Mr. Miller found 25 per cent. of the names defective. False concord between the generic and specific words is the most frequent source of error, on account of the worker's ignorance of Latin; and, even if the original name be correctly rendered, a subsequent writer often alters the genus and does not adapt the trivial name to the gender of the new generic word. As Mr. Claypole had not the opportunity of seeing all the sheets of the catalogue whilst going through the press, he has carefully formed an accurate Index of the Palæozoic genera (pp. 247–253) as to their genders—a great boon to many non-classical writers. *Phlegethontia*, however, is set as *masc.* instead of *fem.*, probably by misprint; and we think that the Latinized form *Macrocheilus* might pass as *masc.*, although the Greek *Macrocheilos* would be neuter, and should be used instead of the former if the latter gender be desirable. So also *Temnocheilus*.

The use of diphthongs is attended to more carefully in this than in some other palæontological works; but *Leptena* (at page 7), *pygmea* (p. 59), *hemisphericus* (pp. 44, 137, and 244), *meandrina* (p. 56), and *Phillipastrea* (p. 251) are wrong, for want of the diphthong. This is dropped by some French writers, who then make the single letter strong with an accent in their own language, and unfortunately ignore the diphthong in the Latin.

Both French and German titles are badly quoted at pages 48, 56, 95, 193, 219, and at pp. 166, 209, 215, 220, &c. Hence a wider knowledge of these modern tongues is evidently desirable.

There are many slips in the etymology of names, which may be advantageously corrected in the next issue of the "Catalogue." Thus *Aristides* is surely historical, and not "mythological" (p. 166). It must be *umbel-bearing* and not "umbrella-bearing" that is intended at page 60; *amphi* (p. 209) means "around" or "on both sides," and not "doubtful." "Lithofactor" and "petrifactor" are meant for *makers of* and not "made of" stone (p. 212); and *Favosites* has less to do with any "proper name" (p. 244) than with *favus*, a honeycomb. Some etymologies are stretched, as "insignificant," instead of "useless," for *inutilis* (p. 130); *securis*, "axe-shaped," instead of "axe"; *sigillate*, not "sealed," but "adorned with figures" (p. 212); and why should *regularis* mean "formed in bars"?

These slips and misprints constitute, however, but very slight drawbacks in the profitable use of this excellent, well-considered book by those wishing to refer to it as a trustworthy epitome of Palæozoic fossils; and the student will here find very much to help him in recognizing the value and estimating the right form and status of their scientific names. The hard pedantry, however (adopted by others besides the author of this work), of denying initial capitals to all specific names, whether nouns, proper names, or adjectives of the latter, takes away many a good and useful sign

from the non-classical student, whereby he might have been guided among apparently similar words of bewildering construction, and have seen at a glance, not only the grammatical value of the trivial name, but often the history of the determination of a species, now obscured in the featureless dog-Latin of ill-recognized nouns, and personal or geographical adjectives of doubtful aspect.

In the use of proper names it would be well if nomenclaturists would always apply the genitive in the case of the species being named after its *discoverer*; and the adjective form when some other relationship is in view, such as when a species is named in honour of some one connected with the study of the group or of the locality.

Mr. Miller's Introduction on the Stratigraphy of the North-American Palæozoic rocks is full of information on the nature of the strata and their characteristic fossils, as elucidated by the many excellent geologists of the United States, Canada, Nova Scotia, &c. The maximum thickness of the stratal groups constituting these old rocks, as here shown, is:—

	feet.
Carboniferous strata	24,100
Devonian	15,235
Upper Silurian	8,000
Lower Silurian	48,745
Huronian	20,000
Laurentian	32,750
	148,830

Even if the thickness of some of these groups be overestimated, and should portions of them be contemporaneous, yet, as some strata may have been omitted and others undervalued, the author thinks that the hypothetically vertical thickness of the whole is not likely to be less than 28 miles, and may be more, and that all but the lowest three miles are fossiliferous. He draws strong inferences as to the upspring and progress of the organic world by "processes of evolution and the survival of the fittest," and insists on the enormous lapse of time necessary for the accumulation of the strata under notice.

We are sure that this careful and well-printed Catalogue will be welcomed by all palæontologists; and it will be especially useful in the comparative study of Silurian fossils as treated in Dr. Bigsby's 'Thesaurus Siluricus' (see Ann. & Mag. Nat. Hist. ser. 4, vol. iii. pp. 314–317), and those of the Devonian and Carboniferous formations, amassed and annotated in his forthcoming elaborate volume devoted to those fossils.

MISCELLANEOUS.

Preliminary Notice of a Species of Phasmidæ *apparently possessing all the Structural Arrangements needed both for Aerial and Aquatic Respiration.* By J. Wood-Mason, F.G.S.

My attention has just been drawn by my friend Mr. Charles O. Waterhouse, of the British Museum, to a Phasmidan insect which, of the

many remarkable forms of animal life that the great island of Borneo has yielded, is certainly not the least remarkable. The insect in question is closely related to the *Prisopi* *, but is even more profoundly modified for an aquatic life; for it breathes not only in the ordinary fashion amongst insects by means of tracheæ opening by stigmata on the exterior of the body, but also by the structures known as tracheal gills. From each side of its body, in fact, along the lower margins of the sides of the metathorax, there stand straight out five equal small but conspicuous ciliated oval plates, which, when the insect is submerged and its stigmata are closed, doubtless serve to bring the air that is thus shut up within the body into such intimate relation either with the oxygen dissolved in, or with the air in mechanical mixture with, the water as to render diffusion and consequently respiration possible.

The only other insect known to me in which during adult life ordinary aerial respiration and respiration by tracheal gills coexist is *Pteronarcys regalis*, one of the Orthoptera Amphibiotica.

For this remarkable form I beg to propose the name *Cotylosoma dipneusticum*.

The insect, which is a female with rudimentary organs of flight, is between three and four inches in length.

Auriferous Sand in the Neighbourhood of the Seychelle Islands. By H. J. Carter, F.R.S. &c.

Belonging to the late Dr. Bowerbank was a little pill-box partly filled with sponge-spicules, and labelled "Dust from the Base of Dr. Farre's *Euplectella*, 26th Feb. 1857." This sponge, designated by Prof. Owen "*Euplectella cucumer*," was stated by Dr. A. Farre (in whose possession it is or was) to have been "given with other presents, by the king of the Seychelle Islands, to Captain Etheridge, R.N., in acknowledgment of some friendly services, with an intimation that it was one of the rarest products of these regions" (Trans. Linn. Soc. vol. xxii. p. 122); and inferring, from actual experience ('Annals,' 1873, vol. xii. p. 463), that the "dust" would be found to contain a variety of spicule forms, indicative of so many of the sponges that must now live, or have lived, in this locality, it was boiled during *six minutes* in strong nitric acid to rid it from all calcareous and soft substances previously to mounting in Canada balsam for more deliberate observation with the microscope. Six slides were thus made, bearing material of different degrees of fineness, from the most subtle that could be preserved to the coarsest in the box, when it was found to contain, as might have been expected, a quantity of sand (for the "dust" came from a mass of sea-bottom still held together in the root-spicules or beard of the *Euplectella*).

But what was most striking, when this sand (about, perhaps, a grain in weight) came to be examined, was the presence of minute

* For an account of the habits of these animals see Andrew Murray in Ann. & Mag. Nat. Hist. 1866, 3rd ser. vol. xviii. p. 265.

fragments of gold and blue sapphire, to the amount apparently of one fiftieth part—the former often united with quartz, and more or less covered by an opaque uncrystalline substance of a yellow-red colour, like that about the "gold-quartz" of California.

This is the first time out of the many "sea-bottoms" examined from different parts of the world that I have found gold present; and as the Seychelle Islands are composed of granite, it seems to me desirable, when the opportunity offers, that they should be prospected for "auriferous quartz."

To the different forms of sponge-spicules, which prove *to me* that the "dust" came from *this Euplectella*, I shall advert on a future occasion.

On a new Marsupial from Australia. By Prof. R. Owen, F.R.S. &c.

The Australian marsupial, the subject of my note in the 'Annals and Magazine of Natural History' for December 1877. I have since found described in the 'Proceedings of the Linnean Society of New South Wales,' Sydney, 1876, p. 33, under the name of *Hypsiprymnodon moschatus*, by the accomplished Curator of the Australian Museum, Sydney, E. Pierson Ramsey, F.L.S., C.M.Z.S.

Metamorphosis of the Cantharis (Cantharis (Lytta) vesicatoria). By M. Lichtenstein.

For a long time the entomologists of all countries have sought to discover the transformations of the Cantharis. In 1837 M. Mulsant, of Lyons, said, in his 'Histoire des Vésicants,' "The study of the metamorphoses of the Cantharides will furnish the subject of a curious chapter to the naturalist who shall succeed in tracing their development."

Since this period I have investigated this question; and now, at length, I believe I can give the entire history from the egg to the pupa.

On the 27th of June I took numerous Cantharides from the ash, selecting fecundated females having the abdomen distended with eggs. Two or three days afterwards they set to work to dig into the earth in the vessel in which I kept them, and, in the little cylindrical holes they formed, deposited masses of from fifty to sixty eggs and more, agglomerated together, and of a hyaline whiteness. About seven days after the oviposition there issued from these eggs larvæ, called by Léon Dufour *Triungulini*, and figured by Réaumur, Ratzeburg, and Mulsant. They are 1 millim. in length, and of a dark brown colour, with the two segments of the meso- and metathorax and the first segment of the abdomen whitish. The abdomen is terminated by two long filaments. This was previously known.

After a thousand fruitless trials, I succeeded in getting these larvæ to accept an artificial nourishment, consisting of the stomachs of bees which had just sucked the juices of flowers. These larvæ

increased in size; and five or six days afterwards their skin split. There then appeared a perfectly different larva, of a milk-white colour, without caudal appendages, and having only very soft integuments in place of the coriaceous envelope which it had just thrown off. Here, again, I was obliged to feel my way to find an acceptable food; and supposing that in nature the larvæ live on the concreted honey of the subterranean bees of the genera *Halictus*, *Andrena*, and their allies, I offered them honey of *Osmia*, and especially of *Ceratina*, the only one I had at hand in my apiaries.

Although considerably objecting to this nutriment, which evidently is not that intended for them by nature, my larvæ, finding nothing else in the glass tubes which served as their prison, ate the honey of *Ceratina*, grew, and moulted three times. Gradually the jaws, at first smooth and much pointed, acquire first one, and then two teeth on the inner side; the antennæ change in form; the eyes, at first very visible, disappear by degrees; and finally, in about thirty days, a larva, arrived at its full development (about 2 centims. in length), moved uneasily in its tube, indicating sufficiently that it wanted a condition indispensable to its transformation, namely the earth.

I was willing enough to furnish it with this, but wished at the same time to be able to continue to observe it. I therefore took a glass tube about 2 centims. in diameter, stopped at its extremity by a piece of sponge, and 3 inches long; this I buried in the moist earth of a vessel; then, after filling it with garden mould, I put my larva into it. The latter soon set to work with ardour; by the aid of its strong legs and horny mandibles, it quickly buried itself and concealed itself from my view. This was on the 7th of September; after waiting eight days I carefully drew out the glass tube, and, to my great joy, saw against its walls a small rounded cell in which the larva reposed. But the next day (16th September), and therefore nine days after it had buried itself, the skin of this last larva split in its turn and left me in presence of the *pseudonymph*, which is common, I believe, to all the Vesicantia; that is to say, there is a true chrysalis with a coriaceous envelope surrounding the actual nymph, which will be afterwards marked out.

I ought, perhaps, to have waited for the exclusion before making the present communication to the Academy; but as the last transformation will not take place till towards the spring, I thought that it would be of interest to make known the Cantharis in its different forms from the egg to the *pseudonymph*. The latter is slightly arched, of a light brown colour, with the head and feet showing themselves in the form of obtuse mamillæ. The skin of the larva is completely thrown off, whilst in *Meloë* it half envelops the pseudonymph, and in *Sitaris* covers it entirely *.—*Comptes Rendus*, October 1, 1877, p. 628.

* This summary will be completed in a memoir that I am preparing with M. Valéry Mayet, who is at present busy making the drawings of the different states of the insect. This paper will appear in the 'Annales de la Société entomologique de France.'

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[FIFTH SERIES]

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XIV.—*Notes on British Spiders, with Descriptions of some new Species.* By the Rev. O. P. CAMBRIDGE, M.A., C.M.Z.S., &c.

[Plate XI.]

MY last communication on British spiders was made two years ago (Ann. & Mag. Nat. Hist. 1875, xvi. pp. 237–260, pl. viii.). Since that time numerous other avocations have prevented any very extended researches in British arachnology. The results, however, of my own observations, and of the kind help of some other naturalists, are subjoined. From these results I have now to record five species supposed to be new to science, and five others previously described, but only discovered in Great Britain during the last two years. Ten species are thus added to our list of indigenous spiders, which now reaches a total of 484 species. Details of all these additions will be found below, as well as some rectifications of synonymy, with observations on habits and other points conceived to be of interest to araneologists, both in respect to the new additions and to some other species also.

In the communication mentioned above, I remarked upon the very scanty materials extant for any list or history of *Irish* spiders; and an appeal was made to Irish naturalists to collect and send me spiders from Ireland. I have had one kind response to this from Mr. T. Workman of Belfast, who has sent me a good many spiders during the last year, all of them, however, belonging to species already known, and one only being of any rarity—*Drepanodus albipunctatus*, Cambr. (*vide*

infrà, p. 115). I now await further collections, kindly promised to me by Mr. Workman; and I venture again to ask other Irish naturalists to collect and send me spiders from their several localities, so that after a while I may have a fair amount of material for a "List of the Spiders of Ireland." Collectors need not be at the trouble of separating their captures; all I desire is some of every kind; and these can be safely sent to me by post in strong half-ounce or one-ounce phials.

Order ARANEIDEA.

Fam. **Theraphosides.**

Genus ATYPUS, Latr.

Atypus piceus.

Atypus piceus, Sulzer, Cambr. Ann. & Mag. N. H. 1875, xvi. p. 238, pl. viii. fig. 2

Atypus Sulzeri, Blackw. Spid Great Brit & Ireland, p. 14, pl. i. fig. 1.

Since the publication of my last notice of this species (*l. c. suprà*) no further materials have come before me for the more satisfactory determination of the synonymic position of this and our other species of the genus *Atypus*. I have, however, lately found a strong colony of this spider under the overhanging ledges of a heathy bank on Bloxworth Heath; and examples of both sexes in the adult state have been kindly sent to me not long since from Hampstead by Mr. F. Enock of London. The remarks made (*t. c.* p. 240) upon the nests of *A. Sulzeri*, have been fully confirmed by the observations made since upon the nests dug out here, and upon those received from Mr. Enock. On one point, however, I am still in doubt; and that is, in regard to the branch occasionally found leading into, or out of, the main tube. Out of ten tubes dug out on Bloxworth Heath, four were furnished with a branch; but no two of them exactly resemble each other, either in the size or in the position of the branch. In one instance the branch issued from the tube at about $2\frac{1}{2}$ inches from its lower extremity, and, running upwards at an acute angle, protruded from the surface among the heather-stems, exactly like the main tube and at about 3 inches from it, the branch, however, being about half the size of the tube, which measured $8\frac{1}{2}$ inches in length. In another instance the branch issued from the tube at about the same distance from its lower extremity, but, instead of running upwards, it ran *downwards*, at an acute angle, to a depth of about 2 inches, being, however, as large as,

if not rather larger than, the tube itself. In another instance (one of Mr. Enock's Hampstead examples) the branch issues close to the surface of the ground, and appears to form merely a short supernumerary entrance to the tube: in this case the branch is no more than an inch long. I am unable to conjecture what the significance of these branched tubes may be. In regard to the trapdoor spiders of South Europe, the researches of the late Mr. Moggridge appear to prove that the presence or absence of branches to the main tubes indicate specific distinctions in the spiders by which they are formed; in the present instance, however, this is certainly not so. A somewhat similar branching has been found to exist occasionally in the tubes of a New-Zealand species of *Nemesia* (*N. Gilliesii*, Cambr.); but in this instance I have conjectured that, the main tube having become choked (as has been the case) with débris of insects and other extraneous matters, the formation of a fresh portion of tube became necessary. In the branched tubes of *Atypus piceus* the branches have not been in any way choked. The enlargements met with in all the larger tubes are probably intended for the reception of the egg-cocoon, and subsequently for the accommodation of the infant brood until such time as they leave the home nest and form separate tubes for themselves. In all cases that have come before me the upper (and projecting) extremity of the nest has been devoid of any perceptible orifice. It struck me at first that there might be an elasticity in that portion of the tube, which, while permitting the spider to effect its exit and return, would cause the orifice again to close. I am now inclined to think that the spider gnaws its way out, and after its return closes the orifice by fresh threads with its spinners, an operation which it would perform without difficulty in a very few minutes.

Before separating and spinning tubes for themselves, the young brood appear to leave the home nest and take up their residence in an irregular web spun among the surrounding herbage. This, at least, is the conclusion I come to from Mr. Enock's finding a considerable number of young in a web on a broom-bush close to the colony in April 1876. These young were much smaller than 129 others found, in the November following, within a tube. One of the tubes dug out on Bloxworth Heath in September 1877 contained, in the enlargement near its lower extremity, about 100 very small young ones.

The three adult males found by Mr. Enock were all in tubes.

Fam. **Dictynides.**

Genus LETHIA, Menge.

Lethia patula, sp. n.

Lethia patula, Sim (*in literis*).

Adult female, length 2 lines.

Cephalothorax oblong-oval, moderately convex above; caput rather long; lateral margins at its junction with the thoracic segments strongly constricted, fore part rather broad and truncated; occipital region rounded, and forming the highest part of the cephalothorax; hinder slope gradual; height of the clypeus greater than the diameter of one of the fore central eyes, but less than half the height of the facial space; the normal grooves and indentations are visible, but not strongly marked. The colour of the cephalothorax is yellow-brown, darkest on the caput, glossy, and with a few coarse hairs on the upper part, chiefly towards the fore part of the caput, and on the clypeus.

The *eyes* are of moderate dimensions, and not very unequal in size; they are disposed in four pairs, forming two nearly straight lines not far removed from each other. Those of the anterior row are separated from each other by equal intervals of about an eye's diameter. The interval between those of the hind central pair is rather less than that between each and the lateral eye of the same row on its side; those of each lateral pair are seated obliquely on a tubercle, but are distinctly separated from each other, though by a rather less interval than that which separates the fore and hind central pairs.

The *legs* are short and not very strong, and their relative length is 4, 1, 2, 3. They are of a brownish-yellow colour with a very faint trace of darker annulations, which may perhaps be more marked in some examples than in others; they are furnished with numerous coarse bristly hairs; and the posterior side of the metatarsi of the fourth pair have a calamistrum which runs throughout almost the whole length of the joint.

The *palpi* are of moderate length, and are similar in colour and armature to the legs.

The *falces* are strong, of moderate length, prominent at their base in front, straight, and perpendicular; they are of a dark yellow-brown colour, furnished with bristly hairs, and armed at their extremities on the inner side with several small teeth of different sizes.

The *maxillæ* are rather large, of an elongate-oblong form, obliquely truncated on the outer sides at their extremity, and inclined towards the labium; they are of a yellow-brown colour, tipped with a paler hue, and furnished with coarse hairs, some of which (of a papilliform nature) from a kind of tuft at their extremities.

The *labium* is of an oblong form, rounded at its apex, and about two thirds as long as the maxillæ, to which it is similar in colour.

The *sternum* is heart-shaped, furnished with coarse hairs, and similar in colour to the cephalothorax.

The *abdomen* is oval, and of considerable convexity on the upperside; its colour is yellow-brown with various indistinct markings of a paler hue, many of them, however, being furnished with coarse whitish hairs; it has thence a more distinctly mottled appearance. Two pale longitudinal, rather broken, curved and opposed lines occupy the fore part of the upperside, and are followed (to the spinners) by several transverse angular lines or chevrons, formed of small pale spots, the terminal spot on each side being a small patch or blotch; the pale spots and markings on the sides assume a rather obliquely linear form. In front of the ordinary spinners, which are short and of a yellow-brown colour, is the supernumerary mamillary organ common to the genus. The genital aperture presents the appearance of two roundish reddish-brown openings rather widely separated in a transverse line, and nearly concealed by coarse, dark, bristly hairs.

Although very nearly allied to *Lethia puta* (Cambr.), and resembling it closely in general colours and appearance, this spider is easily distinguished by its much larger size and a different form of the genital aperture.

The specimen from which I have made the above description was kindly given to me by Mons. Eugène Simon, by whom it was found in the summer of 1870, at Newhaven, in Sussex. I have retained for this species the *nom de cabinet* under which it was sent to me by M. Simon.

Lethia albispiraculis, sp. n. (Pl. XI. fig. 1.)

Adult female, length $1\frac{1}{3}$ line.

This spider is nearly allied to *L. patula*, resembling it closely in its general form, hue, and appearance; it is, however, smaller; and the three examples examined are all of a darker hue and of a more closely freckled look upon the abdomen, upon which also the spots of white hairs are very distinct, though liable to be rubbed off, and so to leave only the brownish-yellow hue of the markings. A very tangible dis-

tinction is furnished by the spiracular plates beneath the fore extremity of the abdomen: these are of a bright white colour, and in some examples are shining and very conspicuous.

Three examples, all females, were found under stones on the Chesil beach, close to the Isle of Portland, in June 1875. This spider is also nearly allied to *L. puta*, Cambr.; but it is rather larger, darker-coloured, and of a shorter, stouter form; it is also easily distinguished from that species by the white spiracular plates.

Fam. **Drassides.**

Genus GNAPHOSA, Latr.

Gnaphosa anglica.

Gnaphosa anglica, Cambr Linn Trans. xxvii. p. 410, pl. 54. fig. 10.

Adult and immature examples of both sexes of this rare and local species were found in parts of Bloxworth Heath from the 7th to the 16th of June, 1877. This spider secretes itself under stones, but chiefly under the dry crust formed by the desiccation of the small muddy puddles which abound wherever the turf has been previously pared off for fuel. In these situations there is generally, until after midsummer, the amount of dampness so essential to the life of many spiders.

Genus DRASSUS, Walck.

Drassus delinquens.

Drassus delinquens, Cambr. Ann & Mag. N. H. 1875, xvi. p. 245, pl. viii. fig. 4.

An adult male and two adult females were found in similar situations to those in which the last species was found, on the 7th of June, 1877.

The male differs very little in size, colour, or markings from the female (though both sexes vary considerably in respect to size); as, however, the male has not yet been described, it will be well to make one or two observations upon it. With regard to size, the length of the male found is 2¾ lines, that of one of the females very nearly 3 lines, the other female being just 2 lines.

The *palpi* of the male are moderately long and tolerably strong, of a dull yellow colour, the radial and digital joints being tinged with dull orange-brown; the radial and cubital joints are short; the former is rather the shortest, and has its fore extremity on the outer side produced into a strong tapering

apophysis as long as the joint itself, and rather dilated at its extremity, very nearly resembling in this respect that of *Drassus troglodytes*, C. Koch. The digital joint is large, of an oval form, and longer than the radial and cubital joints together. The palpal organs are well developed, of a tumid-oval form behind, marked with two parallel fine brown circumferent lines; and there are some rather prominent processes towards their fore extremity.

This spider is nearly allied to *Drassus minusculus*, L. Koch (which appears to be rather common in France); but, I think, on a careful comparison of the two species, it is quite distinct. The differential characters are slight; but among them may be mentioned the closer proximity to each other of the eyes of the hind central pair, and a slight difference in the form of the genital aperture of the female. The only examples I have seen of *D. minusculus*, L. K., are also considerably smaller than those of *D. delinquens*.

Drassus pubescens.

Drassus pubescens, Thor. Recensio Critica Aran. Suec. p. 100, and Syn. Europ. Spid. p. 203; L. Koch, Die Arachn.-Fam. der Drassid. p. 123, tab. v. figs. 77–79; O. P. Cambridge, Trans. Linn. Soc. xxviii. p. 439.

A adult male of this rare and distinct spider was found, under the dry crust formed in small hollows on Bloxworth Heath, by the drying up of the muddy water contained in them, on the 16th of June, 1877. This is only the second example of the species yet found in England; and it enables me to fix the time of its occurrence, which I was unable to do in regard to the former example recorded in Linn. Trans. (*l. c. suprà*).

Drassus bulbifer.

Drassus bulbifer, Cambr. Proc. Zool. Soc. June 1874, p. 386, pl. li. fig. 13.

An adult male of this spider was found at Lulworth, in Dorsetshire, in June 1877, and kindly sent to me by Mr. C. W. Dale, of Glanville's Wootton. The type of the species, described *l. c. suprà*, was received among a number of spiders of many kinds collected by the late Mr. Richard Beck, of Cornhill, London. Being, at the time when these were sent to me, under the impression that some of them were obtained on the continent of Europe, I concluded that the example of *D. bulbifer* was a continental one. I have since had occasion to doubt this, and I feel convinced now that they were all English specimens. Some were, I know, found near London and others at Hastings; it is probable that the example

referred to of the present spider was from this latter locality; at any rate the example found by Mr. Dale settles the question of its being a British spider. So far as I am aware, it is not yet known on the continent. It cannot be mistaken for any, as yet known, British species of *Drassus*; its black abdomen marked with six pale spots clothed with white hairs on the upperside, and its yellow legs, the femora of the first two pairs being black, render it a very striking and distinct-looking spider. Between the four anterior white spots on the abdomen is a large, oblong-oval, shining, deep-brown-black patch.

Genus Clubiona, Latr.

Clubiona cærulescens.

Clubiona cærulescens, L. Koch, Die Arachn.-Fam. der Drassid. p. 331, pl. xiii. figs. 213–215.
Clubiona voluta, Cambr. Journ. Linn. Soc. xi. p. 533, pl. xiv. fig. 3.

When this spider was described under the last-mentioned name I had not had an opportunity of examining the female of *C. cærulescens*, L. K.; I have now no doubt of the identity of these two spiders. A second British example of the female was found at Bloxworth several years ago, and overlooked for the time among a number of others of the same genus.

Genus Cheiracanthium, C. Koch.

Cheiracanthium nutrix.

Cheiracanthium nutrix, Westr. Aran. Suec p. 378; Cambr. Trans. Linn. Soc. xxviii. p. 531, pl. xlvi. fig. 4.

The only British examples of this spider yet recorded were found in Lancashire and in Scotland; lately, in September 1877, one was found on Bloxworth Heath, by my son Robert Jocelyn.

Genus Agrœca.

Agrœca brunnea.

Agelena brunnea, Bl. Spid. Great Brit. & Irel. p. 159, pl. x. fig. 102.

This is the spider to which is attributed the little white pear-shaped egg-cocoons attached to grass-stems, rushes, and other portions of low herbage, and frequently found in numerous localities. It is probable, however, that (in the south of England, at all events) the greater number of these are formed by an allied species, *A. proxima*, Cambr., this last species being an abundant one, while *A. brunnea* is very rare. During many years I have never found more than three or four ex-

amples of *A. brunnea, A. proxima* being for a long time mistaken for it. In spite of the frequent occurrence of the little egg-cocoons referred to, as well as of the last-mentioned spider, I have never yet been able satisfactorily to connect them together. The cocoons are covered over, very soon after they are made and the eggs deposited in them, with a coating of clay, which effectually destroys all their form and beauty. This coating of clay answers probably two ends:—first, the concealment of the cocoon and its protection from insect enemies; and, secondly, the protection of the eggs from the too powerful rays of the sun, dry clay being (as is well known) one of the best non-conductors of heat.

An adult female of *A. brunnea* was found at Bloxworth, Dorset, on the 2nd of June, 1876, and an adult male was received, in November 1877, from Mr. C. W. Dale, by whom it was found a short time previously at Glanville's Wootton, Dorset.

A. W. M. Van Hasselt, in a long paper upon the little pear-shaped cocoons referred to (Tijdschr. Ent. xix. pp. 28–42, pl. i. 1876), comes to the conclusion that there are certainly two, if not more, species of *Agrœca* by which they are constructed; the cocoons differing perhaps in size, and the external coating of clay being possibly of specific importance.

Genus Leiocranum, L. Koch.

Leiocranum prælongipes.

Drassus prælongipes, Cambr. Ann. & Mag. Nat. Hist. June 1861.
Leiocranum prælongipes, Cambr. Trans. Linn. Soc. xxviii. p. 439, pl. xxxiii. fig. 4.

On the 22nd of June, 1877, I met with this hitherto very rare spider in abundance among the coarse star-grass on the sand-hills close to the sea at Studland, Dorsetshire. Both sexes were present; but none had quite attained maturity.

Fam. **Agelenides.**

Genus Tegenaria, Latr.

Tegenaria campestris.

Tegenaria campestris, Walck. Ins. Apt. tom. ii. p. 9; C. Koch, Die Arachn. viii. p. 34, pl. 263. figs. 615, 616; Cambr. Zool. for 1861, p. 7559, and Trans. Linn. Soc. xxviii. p. 443.

Adults of both sexes were found under old casks and among logs of wood in a fuel-house at Bloxworth in December 1876. Up to that time I had met with this spider but rarely, and always out of doors. I have more lately received it from Mr.

C. W. Dale, by whom adult females were found at Glanville's Wootton, Dorset.

Fam. Pholcides.

Pholcus phalangioides, Fuessl.

An opportunity occurring not long since of observing the mode in which this spider secured its prey, the following notes upon it will perhaps be worth recording.

A fly of tolerable size became entangled among the outer lines of the snare; the spider immediately approached, but no nearer than just to reach the fly with the legs of the hinder (or fourth) pair; it then drew silken lines from its spinners, and secured them to the fly with the same legs; this was immediately followed by a rapid alternate winding action upon the fly, effected also by the hinder pair of legs, occasionally assisted by one of those of the third pair; the fly was thus quickly and completely wound up, and then at once carried off to the recesses of the snare in the claws of the fourth pair of legs. No bite was inflicted upon the fly, which possibly may have been thus kept a living captive for days to come in the spider's larder. A very similar mode of securing their prey is also adopted by some species of Epeirides.

Fam. Theridiides.

Genus Pholcomma, Thor.

Pholcomma gibbum, Westr.

Theridion projectum, Cambr. Zoologist, 1862, p 7962.

An adult male and female of this curious little spider were found in the sheltered angle of a verandah at Bloxworth on the 19th of February, 1877, and another male in the same situation on the 10th of April following. These examples had probably lived through the winter in the adult state; those captured in former years were generally found adult from the beginning to the end of summer, and at the roots of heather.

Genus Theridion, Walck.

Theridion familiare.

Theridion familiare, Cambr. Trans. Linn. Soc. xxvii. p. 418, pl. 55, fig. 15.

Adults of both sexes were found in the angles of the woodwork of doors of outbuildings at Bloxworth Rectory on the 12th of July, 1877. I have not met with this spider in any

other locality; nor has it yet been noted upon the continent of Europe.

Theridion tepidariorum.

Theridion tepidariorum, C. Koch, Die Arachn.; O. P. Cambridge, Entomologist, July 1877, vol. x. p. 175.

On the 12th July, 1877, I met with an adult male of this species in the porch of Bloxworth Rectory. This example is very much smaller than those usually found in greenhouses and hothouses, and it is only the second example I have ever found in any other than these situations (*conf.* 'Entomologist,' x. p. 175, where an adult male is recorded as found in a carrot-bed in the kitchen garden at Bloxworth; this specimen is still smaller than the one found in the porch). It is probably a spider of great delicacy of constitution, and therefore of great rarity, except in such favourable situations as a greenhouse or hothouse, where it would naturally thrive well and grow to a comparatively large size.

Genus ERIGONE, Savigny.

Erigone (*Neriene*, Bl.) *longipalpis.*

Neriene longipalpis, Sund.; Cambr. Linn. Trans. xxviii. p. 447, pl. 34. figs. 23, 24.

Adults of both sexes of this spider were found, under débris &c., on the sands near the seashore at Studland, on the 22nd of June, 1877. I have hitherto found this species very rarely in the south of England, the more abundant (though very closely allied) forms being *Erigone dentipalpis*, Westr., and *E. atra*, Bl., both of which also occurred at Studland and in a similar situation.

Erigone (*Neriene*) *Clarkii.*

Neriene Clarkii, Cambr. Linn. Trans. xxvii. p. 441, pl. 56. fig. 20, and Ann. & Mag. Nat. Hist., Oct. 1875, p. 246.

An adult male of this rare spider was found under a piece of old board in the garden at Bloxworth, on the 24th of May, 1877.

Erigone (*Drepanodus*, Menge) *albipunctata.*

Neriene albipunctata, Cambr. Linn. Trans. xxviii. p. 451, pl. 34. fig. 15, and p. 541.

An adult male and female were found among the coarse star-grass and other herbage on the sand-hills near the sea at Studland in June 1877. These are the first females I have met with; and they differ from the male only in the absence

of the great development of the falces so conspicuously characteristic of that sex. I have lately received an adult male of this spider from Mr. T. Workman, by whom it was found and kindly sent to me from the neighbourhood of Belfast.

Erigone (*Walckenaëra*, Bl.) *erythropus.*

Walckenaera borealis, Cambr. Zoologist for 1862, p. 7967.
W. erythropus, Menge, Cambr. Linn. Trans. xxviii. p. 453.

An adult male of this rare species was found among star-grass on the Studland sand-hills in June 1877.

Erigone (*Walckenaëra*, Bl.) *affinitata.*

Walckenaera affinitata, Cambr. Zoologist, 1863, p. 8591; *id.* Linn. Trans. xxviii. p. 451.

In company with the last spider I also found a single example of the adult male of this very rare and distinct species.

Erigone (*Walckenaëra*) *atro-tibialis*, sp. n. (Pl. XI. fig. 3.)

Adult female, length 1 line.

The *cephalothorax* is oval; the lateral constrictions on the margins of the caput are not very strong; but when looked at in profile there is a deep curved notch or indentation, caused by the slight elevation of the upper part of the caput and the rather unusual elevation of the thoracic junction. The colour of the cephalothorax is yellow; the caput and normal indentations strongly suffused with black.

The *eyes* are on black spots and in two transverse and almost equally curved rows, forming an oval figure; the foremost row is the shortest. The interval between those of the hind central pair is slightly less than that between each and the hind lateral eye next to it. The eyes of the fore central pair are nearly but not quite contiguous to each other, and appear to be rather the largest of the eight, the rest being very nearly of equal size. The fore laterals are very near to (though distinctly separated from) the fore centrals; those of each lateral pair are contiguous to each other and are placed obliquely on a slight tubercle. The height of the clypeus is equal to half that of the facial space.

The *legs* are moderately long, slender, not greatly differing in length; their relative length appears to be 4, 1, 2, 3; they are furnished with coarse hairs and a few erect slender bristles, and are of a yellow colour, the tibiæ of all four pairs being black.

The *palpi* are moderate in length and strength; the radial

joint is nearly equal in length to the digital, and enlarges gradually from its hinder to its fore extremity, where its size is the same as that of the base of the digital joint. Their colour and armature are like those of the legs.

The *falces* are moderately strong, rather long, perpendicular, and a little divergent at their extremities, and their colour is yellowish suffused with sooty brown.

The *maxillæ*, *labium*, and *sternum* are similar in colour to the falces. The *maxillæ* are rather strong, short, inclined to the labium, but straight.

The *abdomen* is oval, thinly clothed with hairs, and of a sooty-black colour, strongly tinged with dull yellowish on the sides and underneath. The form of the genital aperture (fig. 3, *c*) is characteristic and conspicuous.

A single adult female of this species was found, on the 14th of June 1876, among dead leaves in a wood at Bloxworth. It differs rather from the typical *Walckenaëræ* in the form of the maxillæ, but in no other respects sufficiently to justify its removal from that group.

Genus Linyphia, Latr.

Linyphia? incerta, sp. n. (Pl. XI. fig. 2.)

Adult female, length 1 line.

This spider is very nearly allied to *L. oblonga*, Cambr. (Trans. Linn. Soc. xxvii. p. 433). It is, however, larger and darker-coloured, though resembling that species very closely in general form and appearance. It may be distinguished readily by the larger size of the eyes, which, instead of being, as in *L. oblonga*, all of a pearly-white colour, have those of the fore central pair of a dark hue. The relative position of the eyes is the same in both species. The height of the clypeus exceeds half that of the facial space.

The *legs* are long, slender, their relative length being 4, 1, 2, 3. They are furnished with bristly hairs and long, fine, prominent spines; the length of the spine near the posterior extremity of the tibiæ of the fourth pair is equal to (if it does not exceed) three times the diameter of the joint.

The *palpi* are rather long, slender, and furnished with hairs and spine-like bristles.

The *falces* are long, strong, prominent at their base in front, and strongly directed backwards towards the *maxillæ*. These, as well as the *labium* and *sternum*, are similar to those of *L. oblonga*.

The *abdomen* is of an oblong-oval form, rather flattened, and projects considerably over the base of the cephalothorax.

It is of a dull brownish-yellow colour, with a somewhat darker tapering stripe along the middle of the fore half of the upperside. It is fairly clothed with coarse hairs of a darker colour than the abdomen itself. The genital aperture is large and conspicuous; its form is that of a circle with a portion (less than half) cut off; and it is suffused with red-brown and placed at the hinder part of a circular shining prominence. The spinners are partially concealed by the projecting around them of the somewhat folded integument of the hinder extremity of the abdomen, which shows very strongly several successive transverse folds of the skin, indicating doubtless the once segmented condition of the abdomen in the primæval spider.

A single example of this species was found by myself on the wall of the village school at Bloxworth, on the 5th of June, 1877.

I have included this spider doubtfully in the genus *Linyphia*, to which *L. oblonga* was referred by Dr. L. Koch on account of the spines on the legs. I have still, however, the same doubts as to the generic position of the present spider which I expressed in the description of *L. oblonga* (*l. c. suprà*).

Linyphia furtiva.

Linyphia furtiva, Cambr. Linn. Trans. xxvii. p. 425, pl. 55. fig. 20.

An adult male and two females were found among star-grass on the Studland sand-hills in June 1877. I had only met with it previously (and that very rarely) on Bloxworth Heath.

Linyphia parvula, Westr.

Linyphia longipes, Cambr. Linn. Trans. xxvii. p. 430, pl. 55. fig. 24.

Two adult males were found among low herbage in a plantation on Muston Down, near Bloxworth, on the 11th of June, 1877. It had previously only been found (as British) in Lancashire. It is nearly allied to *L. aëria*, Cambr. (*vide* Ann. & Mag. Nat. Hist. 1875, vol. xvi. p. 252).

Linyphia linguata.

Linyphia linguata, Cambr. Linn. Trans. xxviii. p. 537, pl. 46. fig. 8.

During the summer of 1877 I received an adult female of this spider from Mr. C. W. Dale, by whom it was found at Glanville's Wootton; the only previous occurrence of it was near Berwick-on-Tweed, in the spring of 1872 (*l. c. suprà*).

Fam. Epeirides.

Genus Zilla, Koch.

Zilla acalypha, var. (Pl. XI. fig. 4.)

Epeira acalypha, Walck. Ins. Apt. ii. p. 50; Thorell, Syn. Eur. Spid. p. 454.

Female adult, length 2 lines.

The *cephalothorax* is rather strongly constricted on the lateral margins at the junction of the thorax and caput; this latter is rather produced, and the thoracic portion rounded, with the normal grooves and indentations well-marked; the highest point of the thorax is (when looked at in profile) rather higher than the upper part of the caput, the interval being depressed. The height of the clypeus is about equal to half that of the facial space. The colour of the cephalothorax is yellow. The margins, as well as a strong central longitudinal tapering bar reaching from just behind the eyes to the thoracic junction, black.

The *eyes* are in four pairs, seated on black tubercles: those of the two central pairs form a rectangle whose length is greater than its width, the hind centrals being larger than the fore centrals; those of each lateral pair are rather further from the hind laterals than these are from each other; when looked at sideways the lateral pairs range more nearly in a straight line with the hind than with the fore centrals, these latter being placed on a rather strong prominence.

The *legs* are moderate in length and strength; their relative length (as well as strength) is 1, 2, 4, 3; they are similar in colour to the cephalothorax, and are armed with not very strong spines; the femora are longitudinally but obscurely marked on the outer side with two almost confluent or diffused sooty lines; and the rest of the joints, particularly the tibiæ, are spotted and blotched with black.

The *palpi* are rather slender, moderate in length, and similar in colour and markings to the legs.

The *falces* are short and moderately strong, conical, directed backwards, and strongly suffused with brown.

The *maxillæ* and *labium* are of normal form, of a dark black-brown colour, tipped with yellowish.

The *sternum* is also of a similar colour.

The *abdomen* is large, of an oval form, rather pointed in front, where it projects greatly over the base of the cephalothorax; the upperside is of a yellowish-white or cream-colour, marked with a very distinctly defined, black marking, oblong behind, and continued almost to the fore extremity in the form

of a stripe, whose fore part runs off to a point and has a prominently projecting point on each side, making it of a somewhat *fleur-de-lys* form; on each side near the fore extremity is also another curved black marking; the oblong black area has four white spots near the middle in two pairs, forming an oblong figure; the foremost pair are much the largest. The sides are dark brown, marked obscurely, but somewhat obliquely, with two black stripes towards the hinder part; the underside forms a black area bounded on each side with a broken longitudinal stripe formed by some yellowish-white blotches.

The example above described was found and kindly forwarded to me by Mr. C. W. Dale from the Isle of Portland, in September 1877. It appears to me to be only a variety of *Zilla acalypha*, Walck.; but its markings are so very distinctly and strongly defined that I have been induced to figure it and to describe it at length: out of many hundred examples of the species that have come under my notice (both British and continental European) no such variety has ever been before observed.

N.B. The legs of the first two pairs in the figure (fig. 4, Pl. XI.) are rather too short.

Epeira Westringii.

Epeira Westringii, Thorell, Recensio Critica Aranearum, p. 106; *id.* Syn. Eur. Spid. pp. 22, 548.

This spider is closely allied to *E. cucurbitina*, Clk., resembling it remarkably in general appearance, structure, and colour; it may, however, be distinguished without difficulty (in the male sex at least) by the absence of the two dark longitudinal bands on the cephalothorax, and by the smaller size of the digital joints of the palpi (including the palpal organs); these latter are also a little different in their structure. I cannot at present lay hold of any such tangible distinctions between the *females* of *E. Westringii* and *E. cucurbitina*. Dr. Thorell remarks (Syn. Eur. Spid. p. 549) upon the difficulty of distinguishing these, and the more especially as there is another species (not yet found in England), *E. alpica*, L. Koch, equally closely allied to both those other spiders.

An adult male and, I believe, a female also were received at the end of June 1877 from Mr. C. W. Dale, by whom they were found at Glanville's Wootton. This is its first record as British.

Epeira adianta, C. Koch.

Males and females of this beautiful spider (all, however, im-

mature) were found, in their orbicular snares, at Lulworth, in June 1877. I have met with it also in various other localities; and probably it would be found sparingly in most of the wild heathy districts of the south of England.

Epeira diademata, Clerck.

It would be interesting to ascertain exactly at what period the young of this common spider begin to construct the orbicular snare characteristic of the family to which it belongs. On the 18th of May I found a brood of young which had effected their first change of integument; but they were still living in a certain sort of community, and spinning only irregular lines fixed in various directions to the surrounding plants.

Genus CYRTOPHORA, Sim.

Cyrtophora conica.

Epeira conica, Walck., Blackw. Spid. Great Brit. & Irel. p. 302, pl. xxvii. fig. 261.

On the 30th of May 1876 I discovered a very beautiful and perfect web of this spider, spun between the leaves of a pear-tree, the adult female occupying, as usual, the centre of the snare. Observing an unusual appearance in the web near her, I found on a close examination that a space above an inch in length, both above and below the centre of the snare, and enclosed between two adjoining radii, was warped across and across and wound about with white flocculus of an adhesive nature, very similar to that found on the lines of the snare of *Amaurobius ferox*, C. Koch. On a very slight movement of the web the spider raised itself upon the extremities of its tarsi, and by means of a strong muscular movement, aided no doubt by its own weight, imparted to itself a rapid vibratory motion for half a minute or more, repeating it on each disturbance of the web. I have noticed similar vibrations in some other Epeirids and also in *Pholcus phalangioides*. The vibration is probably intended to shake any insect entangled slightly in the outskirts of the snare still further into it; and the adhesive flocculus is doubtless to aid in the entanglement when the final struggle comes.

Genus XYSTICUS, C. Koch.

Xysticus versutus.

Thomisus versutus, Blackw. Spid. Gr. Brit. & Irel. p. 83, pl. iv. fig. 49.
Thomisus pallidus, Bl. *l. c.* p. 82, pl. iv. fig. 48.
Xysticus horticola, C. Koch, Die Arachn. iv. p. 74, tab. 129. figs. 296–298.

After a very careful examination of the types of this spider

and a comparison with the type of *Xysticus pallidus*, Bl., and examples of *X. horticola*, C. Koch (the latter received from Dr. L. Koch), I feel no doubt whatever that these three species are identical. The form of the projections at the outer extremity of the radial joint of the male palpus is very striking, and presents a curiously differing appearance from every fresh point of view. This has, no doubt, in great measure, led to the mistaking of the different individuals for different species. *X. pallidus* is simply the pale (and only slightly spotted) variety. Dr. L. Koch agrees with me in considering the three spiders mentioned above to be of one species; but Dr. Thorell still doubts the identity of *T. versutus*, Bl., and *X. horticola*, C. Koch.

Xysticus sanctuarius.

Xysticus sanctuarius, Cambr. Trans. Linn. Soc. xxvii. p. 405, pl. 54. fig. 8.

Several examples of the adult male of this spider were received in September 1877 from Mr. C. W. Dale, by whom they were found at Lulworth, Dorset. It had previously only been found at Bloxworth. It appears to have been also found recently in several localities in France. (See *Oxyptila sanctuaria*, E. Simon, 'Arachnides de France,' vol. ii. p. 217.)

Genus Thomisus.

Thomisus onustus, Walck.

Thomisus abbreviatus, Bl. Brit. & Ir. Spid. p. 90, pl. iv. fig. 54; Walck. Ins. Apt. tom. i. p. 516.

An immature female and male of this rare and pretty spider were received, in September 1877, from Mr. C. W. Dale, by whom they were found near Wareham, Dorset.

Genus Philodromus, Walck.

Philodromus lineatipes, sp. n. (Pl. XI. fig. 5.)

Female immature, length 1 line.

In its general form and structure this spider resembles *P. aureolus*, Clk. The *cephalothorax* is of a dull brownish-yellow colour, marked on the sides (and on the upper part of the caput, between the eyes) with rather reddish brown, chiefly following the direction of the normal indentations; the ocular region has a few strong bristly hairs upon it.

The *eyes* are placed on slight tubercles, in the form of a crescent; they are small and differ very little in size. The interval between those of the hind central pair is greater

than that between each and the hind lateral eye on its side; and a similar relative distance (though not to so great an extent) obtains in regard to the eyes of the front row. The four central eyes form a quadrangular figure, whose foremost side is the shortest, and its posterior side the longest.

The *legs* are short and moderately strong; those of the hinder pair were wanting; but those of the first are rather shorter those of the second and third, while these last two appear to differ very little in length; their colour is pale yellowish tinged with brown, the femora, genua, and tibiæ being pretty distinctly marked with one or two longitudinal reddish-brown stripes, and they are furnished with hairs and bristles.

The *palpi* are similar in colour and armature to the legs.

The *falces*, *maxillæ*, *labium*, and *sternum* are similar in colour to the legs.

The *abdomen* is of a short oval form, broader towards the hinder part than in front; it is of a dull yellowish red-brown hue marked with some whitish markings on the upperside: those on the fore part leave a longitudinal tapering central stripe; and those on the hinder part form several ill-defined transverse curved lines.

A single example was contained among the spiders forwarded to me several years ago, from Scotland, by Mr. J. W. H. Traill. I have hesitated hitherto to describe it as a new species, owing to the immaturity of the specimen. It is evidently allied to *P. aureolus*, Clk., and to *P. cespiticolis*, Walck.; but the striped legs appearing to me to distinguish it satisfactorily from these species, I now describe it, in the confident expectation that, when adults have been found, my view of its specific distinctness will be fully confirmed.

Genus THANATUS, C. Koch.

Thanatus hirsutus.

Philodromus hirsutus, Cambr. Zoologist, 1863, p. 8565; *id.* Trans. Linn. Soc. xxviii. p. 438.

An adult male and several adult females were found on the 22nd of June, 1877, at the roots of star-grass and other herbage on the Studland sand-hills. The male being new to science, I add here a few notes upon it.

Adult male, length rather over $1\frac{1}{3}$ line.

The pattern on both the *cephalothorax* and *abdomen* is similar to that of the female (fully described *l. c. suprà*); upon the abdomen, however, it is much obscured by the paler parts being of a slightly sooty-grey hue, caused in some measure by

grey hairs; and the whole spider is of a rather darker hue; the legs also are longer. The *palpi* are short; the radial and cubital joints are very short; the former is a little shorter than the latter, and has not, so far as I can make out, any prominence or apophysis at the outer extremity; the digital joint is of a narrow oval form, and exceeds in length the radial and cubital joints together; the palpal organs are simple, consisting of a largish rather prominent oval lobe, with a small prominent corneous process near their fore extremity.

M. Simon writes ('Arachnides de France,' ii. 1875, p. 330), "This species is common on the sand-hills 'de la baie de Somme;' it takes up its abode on the sand at the base of large grassy tufts. The male is unknown."

Fam. **Lycosides.**

Genus Pirata, Sund.

Pirata Knorrii, Scop.

Pirata Knorrii, Cambr. Entomologist, 1877, p. 204.

Dr. L. Koch, of Nuremberg, has kindly sent me an example of this species, received by him from the Isle of Arran. It is nearly allied to, but quite distinct from, *P. piraticus*, Clk. & Blackw. Dr. Thorell (Syn. Europ. Spid. pp. 343, 344) gives the distinctions between *P. Knorrii* and *P. piraticus* at full length, as well as the difference of the former from *P. hygrophilus*, Thor., = *Lycosa piscatoria*, Bl.

This spider will probably be found dispersed over the marshy districts of the Scotch Highlands.

Genus Tarentula, Sund.

Tarentula aculeata, Clerck.

Tarentula aculeata, Cambr. Entomologist, 1877, p. 205.

This spider has hitherto been confused with *T. pulverulenta*, Clk. = *Lycosa rapax*, Blackw.; it is, however, a much larger spider, though resembling it very nearly in colours and markings; the legs are also proportionally longer. The differences in this latter respect are given in full detail by Dr. Thorell (*vide* Syn. Europ. Spid. p. 327).

It is only lately (*l. c. suprà*) that *T. aculeata* has been recorded as a British species, from examples found at Braemar, and kindly given to me by Mr. J. W. H. Traill, of the University of Aberdeen; it will probably be some day found generally dispersed over the Highlands of Scotland. Dr. L. Koch, of Nuremberg, has received it from the Isle of Arran.

Tarentula trabalis, Clerck.

Lycosa trabalis, Clk., Simon, Arachn. de France, iii. p. 257.

An immature female of this distinct species was received in January 1877 from Mr. Edward Parfitt, of Exeter, by whom it was found near that city, and kindly sent to me for determination.

Mons. Eugène Simon, to whom it was subsequently submitted, is also of opinion that it is the same as *L. trabalis*, Clk., found by himself abundantly in France (*vide l. c. suprà*). It has not before been recorded in Great Britain.

The only known British species to which it bears any near resemblance in the general character of its markings is *Tarentula pulverulenta*, Clk. (=*Lycosa rapax*, Bl.).

It may, however, be easily distinguished from that species, in all its stages, by the yellow hue of the whole spider, and especially by the clearly defined, broad, dark, yellow-brown, lateral longitudinal bands on the cephalothorax. The legs are yellow, the femora being annulated with brown. In the adult state its much larger size will distinguish it without difficulty from *L. rapax*, Bl.

Genus Lycosa, Latr. (Cambr.).

Lycosa proxima. (Pl. XI. fig. 6.)

Pardosa proxima, C. Koch, Die Arachn. xv. p. 53, pl. 517. figs. 1453, 1454.

This spider is nearly allied to *L. obscura*, Bl., *L. riparia*, C. Koch, and *L. prativaga*, L. Koch; and a close comparison of its palpi and palpal organs is necessary in order to distinguish it satisfactorily. It is, however, quite distinct from all these; and among other marks of distinction may be noted the longer and more slender palpi of the male and the legs only annulated on the femoral joints. In the figure given of the palpal organs (fig. 6, *b*) the peculiar structure of those parts, which differs distinctly from that of the other species mentioned, may be seen.

This spider occurs not uncommonly in my kitchen-garden at Bloxworth, in the months of April and May; and I met with both sexes in abundance among low herbage on damp flats near the sea at Studland on the 22nd June, 1877.

It is now recorded for the first time as a British species.

Lycosa monticola, Clerck.

Lycosa monticola, Clk., Cambr. Linn. Trans. xxvii. p. 398.

Until this year (1877) I have met with this spider only occasionally in Dorsetshire; but on the 11th of June last

I found it in abundance, both males and females, in the adult state, running about actively on the closely fed and extensive downs between Bloxworth and Blandford; none had yet their egg-sacs attached to the spinners.

Lycosa herbigrada, Blackw.

On the 15th and 16th of June, 1877, I had opportunities of observing the egg-sacs of this spider shortly after their commencement; these consisted each of a hollow disk of pure white silk; some were further advanced towards completion than others; and although the parent spider was with each of the cocoons, none had been yet attached to the spinners. The deposition of eggs in the cocoon probably takes but a very short time, and is most likely effected soon after the sac has attained a hemispherical form. The operation of spinning the opposite silken hemisphere over the eggs would be quickly performed; and the egg-sac is no doubt then at once attached to the spinners. The sac is of a pure white colour until the eggs are placed in it; it then assumes the greenish-olive tint usually observed when afterwards the spider bears it about with her until the young are hatched. The operation of making the egg-sac, laying the eggs in it, and completing it takes place usually under a stone, or beneath the dried crust of previous muddy puddles.

Lycosa herbigrada, although local, is an abundant spider on some parts of the heaths in the south of England, and is one of the prettiest and most distinctly marked of all our indigenous species.

It has been found in Sweden and Germany, but does not appear to have been yet met with in France (*vide* E. Simon, Arachn. de France, tome iii. p. 323).

Lycosa annulata.

Lycosa annulata, Thor., Cambr. Ann. & Mag. Nat. Hist. 1875, xvi. p. 260, pl. viii. fig. 10.
Pardosa hortensis, Sim. Arachnides de France, iii. p. 348.

When this spider was first recorded as a British species I was not able to fix any special locality for it. The examples found in my collection were obtained from Portland and at Bloxworth, or in the neighbourhood, but were mixed up with and mistaken for *Lycosa amentata*, Clk.; I have, however, during the past season, from the 11th to the end of May, found both sexes in the adult state, in tolerable abundance, in Bere-wood, near Bloxworth, at the Yarrells, Lytchett Minster, near Poole, and in other wooded localities in the neighbourhood. It will probably be found to be one of the most abundant

species of *Lycosa* in the woods and waste grounds of the south of England, as it also is, in similar situations, in most parts of France.

Fam. **Salticides.**

Genus HASARIUS, Simon.

Hasarius citus.

Salticus citus, Cambr. Zoologist, 1863, p. 8561.

An adult male of this spider was kindly sent to me in a living state for determination, in 1873, by Mr. F. Smith (of the British Museum). This example was found, I understood, among the botanical collections in the museum, and hence might be considered to have been imported from abroad among some dried plants. In October last (1877) another adult example of the same sex was received from the Rev. A. E. Eaton; this latter example was captured in an orchid-house at the Kew Gardens, where it was most probably introduced with exotic plants. This spider must therefore, so far as our present evidence goes, be considered merely an imported species. It is very nearly allied to *Hasarius Adansonii*, Savigny, but, I think, is distinct from it. This latter species is found in France, Spain, Syria, Egypt, Palestine, Greece, Mauritius, and Bombay. I have undoubted examples of *H. citus* from Manilla; and it is possible that it may eventually turn out to be only an unusually distinctly marked variety of *H. Adansonii*.

Genus MARPESSA, C. Koch.

Marpessa pomatia.

Marpessa pomatia, Walck., Simon, Arachn. de France, iii. p. 26.
Salticus Blackwallii, Clark, Blackw. Hist. Spid. Great Brit. and Irel. p. 62, pl. iii. fig. 34.

I have lately received from M. Simon both sexes of *M. pomatia*, Walck.; and, after a careful comparison of the two, I feel no doubt whatever that it is identical with *Salticus Blackwallii*, Clark. The single example found at Southport, Lancashire, and which formed the type of Mr. Hamlet Clark's species, still remains the only recorded British specimen. It is also a rare spider in France. The palpi and palpal organs of the male are exceedingly remarkable in their development.

List of the Spiders noted and described.

Atypus piceus, Sulz., p. 106.
Lethia patula, sp. n., p. 108.
Lethia albispiraculis, sp. n., p. 109, Pl. XI. fig. 1.

Gnaphosa anglica, Cambr., p. 110.
Drassus delinquens, Cambr., p. 110.
—— *pubescens*, Thorell, p. 111.
bulbifer, Cambr., p. 111.
Clubiona cærulescens, L. Koch, p. 112.
Cheiracanthium nutrix, Westr., p. 112.
Agrœca brunnea, Blackw., p. 112.
Leiocranum prælongipes, Cambr., p. 113.
Tegenaria campestris, Walck., p. 113.
Pholcus phalangioides, Fuessl., p. 114.
Pholcomma gibbum, Westr., p. 114.
Theridion familiare, Cambr., p. 114.
—— *tepidariorum*, C. Koch, p. 115.
Erigone longipalpis, Sund., p. 115.
—— *Clarkii*, Cambr., p. 115.
—— *albipunctata*, Cambr., p. 115.
—— *erythropus*, Cambr., p. 116.
—— *affinitata*, Cambr., p. 116.
—— *atro-tibialis*, sp. n., p. 116, Pl. XI. fig. 3.
Linyphia incerta, sp. n., p. 117, Pl. XI. fig. 2.
Linyphia furtiva, Cambr., p. 118.
—— *parvula*, Westr., p. 118.
—— *linguata*, Cambr., p. 118.
Zilla acalypha, Walck., var., p. 119, Pl. XI. fig. 4.
Epeira Westringii, Thorell, p. 120.
—— *adianta*, C. Koch, p. 120.
—— *diademata*, Clerck, p. 121.
Cyrtophora conica, Walck., p. 121.
Xysticus versutus, Blackw., p. 121.
—— *sanctuarius*, Cambr., p. 122.
Thomisus onustus, Walck., p. 122.
Philodromus lineatipes, sp. n., p. 122, Pl. XI. fig. 5.
Thanatus hirsutus, Cambr., p. 123.
Pirata Knorrii, Scop., p. 124.
Tarentula aculeata, Clk., p. 124.
trabalis, Clk., p. 125.
Lycosa proxima, C. Koch, p. 125, Pl. XI. fig. 6.
—— *monticola*, Clk., p. 125.
—— *herbigrada*, Blackw., p. 126.
—— *annulata*, Thorell, p. 126.
Hasarius citus, Cambr., p. 127.
Marpessa pomatia, Walck., p. 127.

EXPLANATION OF PLATE XI.

Fig. 1. *Lethia albispiraculis*, sp. n., ♀, p. 109: *a*, spider, magnified; *b*, profile of cephalothorax; *c*, eyes and part of falces, from in front; *d*, tarsus and metatarsus of right leg of fourth pair, showing calamistrum; *e*, natural length of spider.

Fig. 2. *Linyphia incerta*, sp. n., ♀, p. 117: *a*, spider, enlarged; *b*, profile; *c*, eyes and falces, from in front; *d*, genual and tibial joints of leg of fourth pair, showing the spines; *e*, maxillæ and labium; *f*, genital aperture; *g*, natural length of spider.

Fig. 3. *Erigone atro-tibialis*, sp. n., ♀, p. 116: *a*, spider, magnified; *b*, profile; *c*, genital aperture; *d*, natural length of spider.

Fig. 4. *Zilla acalypha*, Walck., var., ♀, p. 119: *a*, spider, enlarged; *b*, profile; *c*, eyes, from in front; *d*, natural length of spider.

Fig. 5. *Philodromus lineatipes*, sp. n., ♀, p. 122: *a*, spider, enlarged; *b*, eyes, from behind; *c*, natural length.

Fig. 6. *Lycosa proxima*, C. Koch, ♂, p. 125: *a*, spider, enlarged; *b*, digital joint and palpal organs, highly magnified; *c*, genital aperture of ♀; *d*, natural length of ♂.

XV.—*Mr. James Thomson's Fossil Sponges from the Carboniferous System of the South-west of Scotland.* By H. J. Carter, F.R.S. &c.

[Plates IX. & X.]

Of these fossils I have given a preliminary notice in the 'Annals and Magazine of Natural History' for September

last (vol. xx. p. 176), since which Prof. J. Young and Mr. J. Young have conjointly published an account of the sarco-hexactinellid sponge to which I have therein alluded, under the name of "*Hyalonema Smithii*" ('Annals,' vol. xx. p. 425, pls. xiv., xv.). Their right of priority is undisputed; at the same time my promise to Mr. Thomson, F.G.S., to describe his fossils must now be fulfilled.

It is not, however, necessary for me to do this at length with *Hyalonema Smithii*, as this has already been done (*l. c.*); hence what I have to state will be chiefly confirmatory of what has gone before, having from the commencement, viz. Sept. 1876, been plentifully supplied with fragmentary remains of its accompanying spicules by Dr. J. Millar, who obtained them from Mr. J. Armstrong of Glasgow, in addition to the specimens subsequently sent me by Mr. J. Thomson of the same city. Mr. Armstrong obtained these fragmentary remains, which in many instances are nearly perfect spicules, in great numbers from the rotten detritus with which the crevices of the limestone where *Hyalonema Smithii* abounds are filled; hence my figures must be regarded as partly restored.

Besides *Hyalonema Smithii*, Mr. Thomson has sent me specimens of other fossil sponges from the same system, viz.:— one for which I propose the name of "*Pulvillus Thomsonii*," from Arbigland; and two others, which will be named respectively "*Dysidea antiqua*" and "*Rhaphidhistia vermiculata*," from the same beds as the *Hyalonema*. These will now be described and illustrated successively.

Hyalonema Smithii, Y. & Y.

Of this sponge the separate spicules which I possess were furnished, as before stated, by Dr. Millar; and those which appear to belong to *Hyalonema Smithii* have been identified *in situ* through specimens supplied by Mr. Thomson; while there are others which appear to have belonged to other species of the Sarcohexactinellida, as will be seen hereafter.

Of the cord or stem three fragmentary specimens have been sent to me by Mr. Thomson, two of which are about the same size and also close together in the same piece of limestone. The largest is five inches long and about one inch wide by one sixth of an inch thick, composed of spicules, once long and continuous, but now much fractured transversely, indeed comminutely in some parts; varying in diameter from one twenty-fourth of an inch downwards and presenting distinct although slight undulation (Pl. IX. fig. 1). Moreover the cord is compressed so that in the end view from which the proximal or upper portion has been broken off, and it has thus become ex-

posed by the fracture of the limestone in which it lies imbedded, it does not exceed in the thickest part more than one sixth of an inch, as before stated (fig. 2).

In the smallest of the three specimens, which is not more than an inch long and in which the spicules are much reduced in size and spread out, indicative of the free end of such a cord, is an instance of the terminal or anchoring extremity *in situ*, presenting the same inflated, club-like form we shall find hereafter to be so common among the separate fragments, but with the shaft at its junction with the anchor-like end only 1-120th inch in diameter (fig. 4, *a*).

It is not uncommon, as we shall presently see, to find the cord-spicule grooved longitudinally, in one part singly, or generally and in great plurality throughout its circumference (fig. 13, *b*, *d*, *e*), which has been attributed by the Messrs. Young to pressure from the "adjacent rods" (*l. c.* p. 427); but on examining the end of one of Mr. Thomson's specimens with the microscope, two rather large spicules may be seen close together with a single groove in each, and the material between them and the neighbouring spicules entirely composed of the white granular calcite which fills up the intervals between these spicules, and thus, in the transverse section, contrasts strongly with the dark end of the transparent material of which the spicule is formed, without the presence of any small spicules whatever (fig. 13, *a a*); so that this grooving would appear to be original and not produced by "adjacent rods." Besides, where there are small spicules in distinct contact with larger ones, there is no groove at all observed in the latter, which therefore may be natural although of casual occurrence.

The fragments of the surface of the body of a sarcohexactinellid sponge, attributed to *Hyalonema Smithii*, were also sent to me by Mr. Thomson, in which the characteristic spiculation of the surface in this species is obvious together with the lattice-like structure formed by the intercrossing of the spicules in the Sarcohexactinellida generally. The largest of these pieces is about half an inch long by a quarter of an inch broad (fig. 7), in which there is one of the circular fenestral spaces (now a hole) forming the interstices of the lattice-like structure, also characteristic of the recent Sarcohexactinellida, together with remains of others on the circumference (fig. 7, *b b*), and the peculiar "nail-like" spicules described by Dr. Young (*l. c.* p. 426) of all sizes below 1-6th of an inch in diameter across the head, which is possessed by the few that chiefly bind down the rest with sloping outspread arms, after the manner of this kind of spicules generally (fig. 7, *a a*).

So much for Mr. Thomson's interesting specimens of *Hyalonema Smithii*. Let us now see what the supply of separate spicules by Dr. J. Millar affords.

1. *Fragments of the spicules of the cord.*—These vary in size from half an inch in length downwards, and the largest of the smooth ones 1-24th of an inch in diameter, while the largest of those grooved all round the circumference are 1-24½th of an inch thick. There is nothing remarkable in the smooth form; but the longitudinal lineation of the grooved one may be single or in variable plurality, as before stated—that is, confined to one part only (fig. 13, *b*), or spread more or less equally round the whole circumference of the spicule to the number of thirty-two in a spicule possessing a diameter of the thirty-second part of an inch (fig. 13, *d*, *e*), or may not exceed four at unequal distances from each other in a circumference double this size (fig. 13, *c*). Although I have seen the single groove chiefly in the smaller spicules, I have only seen the entire circumference grooved in the larger ones, with the intervals *convex* like the *fascis* of a Roman *lictor*, not fluted or *concave* like an Ionic column. Whether, however, this grooving, in its extreme degree, belongs to the spicules of *Hyalonema Smithii* or not, the more simple one does, as Mr. Thomson's specimen demonstrates *in situ*; and reasons have already been assigned for its seeming to be original, and not produced by the pressure of surrounding smaller spicules, whose absence is evident where the groove is equally present. Again, although the largest spicules I have seen were grooved throughout the circumference, it does not follow that the grooved spicules are always the largest, as has already been shown.

2. *Fragments with four-armed anchor-like ends.*—These are of two kinds, viz. :—the larger, with inflated or rounded extremity and moderately recurved thick short arms (fig. 5); and the smaller, with pointed extremity and much recurved, longer, and less stout arms (fig. 6). Both kinds have four arms opposite. In the former the shaft is slightly reduced in size to the point where it expands into the arms (fig. 3), or it may be constricted just before this termination, while the arms, which in the normal or more regularly formed ones are thick conical spines of nearly equal length, and nearly crucial or opposite in position, are somewhat recurved (fig. 3, *a*, *b*); but they may vary in length and obtuseness, in the angle at which they separate, and in their degree of recurvation, still always parting from an obtuse or rounded club-like extremity. This is the character of the anchor end *in situ* (fig. 4, *a*), to which I have before alluded; so that we may fairly assign it

to *Hyalonema Smithii.* How far the other form, which, in its largest examples, is not much smaller than the club-shaped end, belonged also to *H. Smithii,* I am not prepared to state; but although some of its largest examples may surpass in size the smallest club-shaped ones, the smallest of the former that has come under my observation does not exceed the 1-360th part of an inch in diameter, and is therefore microscopic, while the largest club-shaped anchoring end reaches 1-16th of an inch, and the smallest that I have seen is still visible to the unassisted eye. Where the shaft is constricted close to the end, the arms are also constricted respectively, so that there is no club-like or rounded extremity, so far as my observation extends, but in its place a crucial depression; hence this is either a variety of the club-shaped anchor end or the anchoring end of a spicule which belonged to another hexactinellid sponge.

3. *Fragments of the "nail-like" spicule.*—One of these, viz. the "nail-like" spicule of (?) *Hyalonema Smithii,* is smooth throughout and consists normally of a shaft with four arms, more or less opposite each other, surmounted by a round head (figs. 8, 9). In size the largest measure about 4-12ths inch across the arms, each arm, which is sharp-pointed, being about 2-12ths inch long, with a thickness at the base of about 1-48th inch; the shaft is about the same, or perhaps a little less, and the round or globular head, which represents a continuation of the shaft, about 1-36th inch in diameter. But all these measurements, as well as the spicules themselves, are subject to great variety, inasmuch as the arms, individually or collectively, may be more or less inclined towards the shaft, and thus not all at the same angle; or they may depart from the shaft at different angles laterally and thus be not opposite; while, in form, one or more may vary from an obtuse point to a short round knob like the head, or be constricted where they join the shaft (fig. 9); while the shaft, which is in a line with the head, varies very little in shape (like the globular head), being for the most part straight and pointed, although sometimes both head and shaft, individually or collectively, like the arms, may be more or less constricted at the base. The position of these spicules in the sponge is illustrated by Mr. Thomson's fragment (fig. 7, *a a*), where the shaft is directed inwards, the head or knob externally, and the arms spreading out laterally slope inwardly, so as in the largest forms to bind down the rest of the structure as in the Sarcohexactinellida generally, all of which, even to the minutest spicule observable on the surface, present the same characteristic head and figure as that above described with its modifications.

Besides the "nail-like" spicule of *Hyalonema Smithii*, small sexradiates with straight, simple, smooth arms, more or less varying from a right angle in their departure from the centre, are observed; but as yet I have not seen any *in situ* (fig. 12).

Add to this spicules with stelliform heads of two kinds, viz. smooth (fig. 10, *a*) and tubercled (fig. 10, *b*), the former of which are much the smallest of the two. All appear to me to have had from six to eight arms or rays spread umbrella-like over a central shaft, while seven seems to be the most constant number. The ray of the smooth stelliform spicule in its largest forms that I have seen does not exceed 1-12th inch in length, thus giving 1-6th of an inch for the whole diameter of the head; while that of the tubercled stelliform spicule is double that length, with a diameter at the base of 1-48th of an inch, thus giving a total diameter for the head of 1-3rd of an inch in the largest forms, which is that of the largest "nail-like" spicules of *Hyalonema Smithii*; while each ray is covered with a number of minute tubercles on its convex or outer side (fig. 10, *b*), which, increasing in size from near the point inwardly, become more prominent as they pass into the continuous area formed by the union of the rays with each other towards the centre (Dr. Young's nos. 19, 27, 29). The rays, which are not straight like those of the "nail-like" spicule, but, as before stated, are incurved like the ribs of an umbrella when open, often vary in length in the same spicule, and depart from the centre at different angles in both the smooth and tubercled forms, so that, instead of all being of the same length and equidistant, as in the normal or more regularly formed spicule, some rays are often shorter than others, and more closely approximated, while the shaft is always straight, smooth, and pointed.

Lastly, another form has been pointed out to me by Dr. Millar, like a double star back to back (fig. 11, *a*, *b*). This consists of a shaft with five smooth, straight arms or rays surmounted by a short, pointed continuation of the shaft in front, which may be minutely tubercled, and five still shorter ones surrounding it, one or more of which may be bifid or trifid (fig. 11, *c*, *c*). Both sets of rays are inclined towards the shaft or central axis, but in opposite directions, the latter, upper and shorter ones (outer *in situ* probably), most so. Here also the arms appear to be subject to the same variety as those of the foregoing spicules, and the spicules themselves to vary equally in size, the largest seen possessing a straight shaft about 3-48ths inch long with a thickness of 1-48th inch at the base.

Thus the largest of all these three kinds of "nail-like" spicules appear to have been about the same size, and the three different forms to have belonged to three different sarcohexactinellids respectively, while the first only has been seen *in situ*; so that each of these three kinds may have been the nail-like body-spicule of a particular species. At the same time it should be remembered that, although the "nail-like" spicule first described has been found *in situ* in the body-structure of the sarcohexactinellid to which it belonged, this body-structure has not as yet been found in *direct* connexion with the cord, and therefore has only been assumed to have been part of *Hyalonema Smithii* from its association with the fossil cords; while the only instance of an anchoring termination like that assigned to *H. Smithii* that has been found in *direct* connexion with the fragment of a cord is that above mentioned. Again, according to the Messrs. Young's statement (*l. c.* p. 428), the cords are so abundant that it may be fairly inferred that they did not *all* belong to the same species of hexactinellid.

The double sagittate form of anchor end, also above mentioned (Pl. IX. fig. 6), may have belonged to one of the species in particular; while the four arms opposite with their varieties, in the cord as well as in the nail-like body-spicule, seem to indicate an alliance with the genus *Rossella* rather than with *Hyalonema* ('Ann.' 1872, vol. ix. pl. xxi.). At the same time the Messrs. Young's statement that "the rods are of unknown length, the largest fragments at Trearne being 12 inches, and of various thicknesses, from 1-40th inch to nearly a line in diameter," shows that they far exceed in dimensions those of the largest specimens of any *Hyalonema* that I have seen, and dwarfs to almost insignificance the longest of *Rossella*, which are only 6 inches with a corresponding thinness ('Ann.' 1875, vol. xv. p. 19, pl. x.), while the anchoring ends of the cord-spicules in the largest recent *Hyalonemata* can hardly be seen with the unassisted eye, being not more than 1-140th inch in diameter.

Replacement of siliceous by calcareous material during fossilization.

Connected with the fossilized spicules of *Hyalonema Smithii* is the fact that many of the fragmentary spicules sent to Dr. Millar by Mr. Armstrong, and obtained, as before stated, from the "rotten material" or decomposed limestone, respectively present all degrees of transition from the siliceous material of which they were originally composed to calcspar (fig. 14, *a*, *b*, *c*); and this may be seen by

the rhombohedral excavations, which may appear singly in some, increased to a plurality in others, which not only has caused them to lose their original outline, but to become fretted into shapes which are chiefly characterized by the angular cavities caused by the encroachment of the calcspar upon the siliceous material (fig. 14, *c*), so that a little more and the whole of the siliceous spicule would have given place to calcareous material. The calcspar has become redissolved; and the rhombohedral cavities which it occupied are thus left to prove the interesting fact first pointed out by Mr. W. J. Sollas, viz. that calcareous material, *i. e.* phosphate of lime, might replace siliceous material in the "vitreo-hexactinellid sponge *Eubrochus clausus* during fossilization" ('Geol. Mag.,' Sept. 1876). This, which is one of the most important discoveries in modern palæontology, on account of the few organisms which possess siliceous skeletons, and the consequent rarity of the occurrence, while the reverse is so commonly the case with calcareous organisms that are replaced by silex, was subsequently put forth by Mr. Sollas in a more extended form in his paper on "*Pharetrospongia Strahani*," read at the Geological Society on the 20th Dec. 1876, and published in May 1877 ('Quart. Journ. Geol. Soc.' p. 242), which is supplemented by a "Note," dated "26th April," in which (p. 254) Mr. Sollas, on account of the objections made to his view in the discussion of his paper, states:—"I need here only remark that while *Siphonia* exhibits the structure of a Lithistid (siliceous) sponge, *Stauronema* of a Hexactinellid (siliceous) sponge, and *Pharetrospongia* of a Thalyosian (siliceous) sponge, yet the fossil skeletons of all three frequently occur now in a calcareous state."

About the same time (remarkable facts are frequently noticed simultaneously by different observers independent of, and at a distance from, each other) Prof. K. A. Zittel of Munich must have come to a similar conclusion, as we learn from the "Note" to his paper on the Hexactinellida, entitled "Studien über fossile Spongien," dated 15th Feb. 1877, wherein it is stated that at the general meeting of the German Geological Society, held at Jena in August 1876, he discussed the conversion of the originally siliceous skeleton [of the Hexactinellida] into calcspar, at which time, in the course of conversation, many objections were made to this chemical substitution (transl. 'Ann.' 1877, vol. xx. p. 516). The report of this meeting was subsequently published in the Zeitschr. d. deutschen geolog. Ges. xxviii. p. 631; after which the paper above mentioned was read on the 13th Jan. 1877, in the Mathem.-Physical Class, and finally published in

the Abhandlungen, der k.-bayer. Akademie der Wiss., II. Cl., xiii. Bd. 1877, wherein (transl. *l. c.* pp. 264–6) Prof. Zittel goes into the question at considerable length, noticing in one part ('Ann.' *l. c.* p. 264) the occurrence of a Hexactinellid sponge from the White Jura of Streitberg, "half calcified, half siliceous."

The objections met with by Prof. Zittel at Jena were not less encountered by Mr. Sollas at the Geological Society of London, where it appears, from the discussion that followed the reading of his paper, that the President "thought it was more probable that the sponge described was one of the Calcispongiæ" (*l. c.* p. 255).

But putting aside the fact that a siliceous spicule may become converted during fossilization into a calcareous one, there can be no harm in showing how improbable it is that *Pharetrospongia* should have been a calcareous sponge, even if the latter ever become fossilized.

In the first place, as regards size, the Calcispongiæ of the present day are not only all very small, but for the most part absolutely diminutive. Secondly, with the exception of half a dozen species (all that appear to be known), none are without the tri- or quadriradiate spicule; while the acerate spicule *in all* is straight, although sometimes undulating in its course, and more or less spined—never, to my knowledge, simply curved in the form of an arc, as in the siliceous spicules of the Renicrida, of which *Pharetrospongia* was one. Thirdly, the Calcispongiæ are so perishable that, although growing exuberantly when alive for the most part on the rocks of the sea-shore, where they are incessantly exposed to the action of the waves, they here become as *diffluent* as Infusoria immediately after death—that is, at once become disintegrated, from the want of that horny fibre and siliceous element which makes the other sponges so lasting. Fourthly, and lastly, their spicules, whether mounted in balsam or drawn in among the foreign bodies forming the core of the horny fibre in the Psammonemata, break up rapidly, and in a very short time, passing into aqueous globules, leave not "a trace behind." Hence I now never mount a specimen of a calcareous sponge for preservation in any thing but a dry and simple cell.

Thus size of sponge, form of spicule, perishable nature both of entire sponge and individual spicule make it almost impossible that *Pharetrospongia* and the like could ever have been Calcispongiæ, even if we had not the proofs above stated that a siliceous spicule may during fossilization become a calcareous one.

I have premised a short account of the discovery of this

fact, as the following description of a fossil sponge from the Lower Limestone of the Carboniferous system of S.W. Scotland, sent to me by Mr. Thomson, affords another instance of a Renierid sponge, in form of spicule somewhat like *Pharetrospongia Strahani*, having passed from the siliceous into the calcareous state.

Pulvillus Thomsonii, n. sp. (Pl. X. figs. 1–6.)

Calcareous fossil. Pulvinate, circular, depressed towards the centre on both sides, contracted towards the circumference, which is round or angular, elevated between (Pl. X. fig. 1). Surface uniformly granular, interrupted by a central circular excavation on each side, one of which is much larger than the other (fig. 1, *a*), and the smallest filled with a stem-like fragment (fig. 3, *a*, *b*). Internal structure granular throughout (fig. 2); granules subround, variable in size, below 1-8th inch in diameter, composed of crystalline calcite, which in the thin vertical section is semitransparent, of a light brown colour and sometimes white (fig. 2, *d d*); imbedded in dark material composed of a heterogeneous mixture of minute particles of sand and organic fragments, often giving place to white semi-crystalline calcite (fig. 2, *e*, *e*, *e*); the whole, in a vertical or horizontal section, presenting the appearance of a granular, minutely veined conglomeration, wherein the veins, especially towards the large excavation (fig. 2, *a*), are much wider than the rest, into which they afterwards appear to become subdivided. Granules largest on the side which is most excavated (fig. 2, *a*), and surrounded generally by a thin proper layer, which may be of a dark lead- or ochraceous yellow colour, according to the specimen; presenting, in a *vertical* section, bundles of smooth, slightly curved, acerate, white, opaque or clear transparent spicules, cut across more or less longitudinally into variable lengths by the plane of the section (fig. 4, *a*, *b*), which, when passing through the granules *horizontally*, fails, except here and there, to show more than the crystalline calcite. Broken ends of the spicules abundant in, and projecting from, the surface of the large excavation, where, from their transparent, crystalline nature, they appear, for the most part, in the form of dark, circular, transverse sections of various sizes, in the midst of each of which is a punctum representing the axial canal (fig. 6, *a*, *b*). Spicule smooth, acerate, fusiform, curved, and gradually attenuated to a point at each end; variable in size, about 1-25th by 1-600th inch in its largest dimensions, the only perfect one seen being smaller, viz. 1-45th by 1-900th inch in its largest dimensions (fig. 5). Size of largest specimen of entire fossil about 5 inches in

horizontal diameter, and 2 inches in vertical diameter between the circumference and the centre, where it is thickest (fig. 1).

Hab. Marine, associated probably, according to Mr. Thomson, with "reef-building corals."

Loc. Arbigland, 14 miles south of Dumfries, on the Solway Firth, Scotland, S.W. In dark grey shale interstratified with thin bands of limestone characterizing the upper part of the Lower Limestone series of the Carboniferous system.

Obs. On account of the presence of the spicules above described, presenting themselves throughout the fossil *sidewise* in the *vertical* section and *endwise* in the large excavation, which would be tantamount to a *horizontal* section, there can be no doubt that this is a fossil sponge, and, on account of the spicules being of one form only and of different sizes, as above mentioned, that the sponge belonged to my order Holorhaphidota and family Renierida, where it would, according to its spiculation, come in well with the first group, viz. Amorphina, and the species *Halichondria panicea*, whose spicules in the deep-sea form &c. ('Ann.' 1876, vol. xviii. p. 470), where they are larger than in the shore one so common on our coasts, are almost identical. It may also be inferred from the spicules appearing abundantly and longitudinally in the vertical, while they are seldom seen in the horizontal section, together with the broken ends themselves in the large excavation, that the direction of the spiculation was more or less vertical. This would have been more satisfactorily confirmed could the transverse section of the bundles have been seen in the horizontal section, as they thus appear in *Pharetrospongia Strahani*, Soll.; but the opaque crystallization of the calcareous material in the "granules" seems to obscure this, since the transverse sections of the scattered spicules in the large excavation, where the crystallization is transparent, are plain enough, with a common lens of two inches focus: and under a magnifying-power of 100 diameters, their axial canal respectively is distinctly seen, which does not exist in the spicules of the Calcispongiæ, except in Häckel's fertile imagination.

For the deep-sea variety of *Halichondria panicea* I have proposed the specific name of "*cancellosa*" (*l. c.*), from its areolar structure; and it may be that the "granules" of *Pulvillus Thomsonii* represent such spaces (fig. 2).

Of course the pores of this sponge have disappeared, from their minuteness and situation in the dermal sarcode; while the excretory canal-system seems to be indicated by the venation between the granules, which in its widest and most dilated parts may, in the section, be observed to be filled with heterogeneous material composed of sand and the remains of organic

bodies such as fragments of shells &c. (fig. 2, *e e e*), while the remote parts, as above mentioned, are occupied by opaque white crystalline calcite alone. The widest parts, too, being on the side of the large central excavation, and particularly leading into the excavation itself (fig. 2, *a*), would seem to show that this was the excretory side, and that the principal outlet was at this excavation; while the smaller venation being on the opposite side of the iossil, seems to point out that this was more particularly the "pore-surface," which, if the sponge grew from the roof of a submarine rocky cavern pendent from the stem-like portion in the smaller excavation (fig. 2, *b*, *c*), would indicate its upper part, and *vice versâ* if it grew from the upper surface of the rock or material on which it was originally fixed; for it has every appearance of having once been pedunculated.

The specimens (of which there are three) are not all exactly alike in their general shape: two, growing from a flat circular base, have risen into a depressed truncated conical form; another has a smooth unequal or undulating subconical side, with three large holes almost equidistant from each other and from the circumference, which, together with the central excavation, look very much like the remains of large vents.

The former (fig. 1) appears to be the prevailing form; but independently of an original difference in this respect, something must be allowed for subsequent alteration during the time the sponge was loose on the sea-bottom before fossilization, and something afterwards; hence it would be absurd to expect that all the specimens should be alike in general form any more than those of recent sponges.

All the spicules with the rest of the fossil are calcareous; at the same time it is worthy of remark that when dilute nitric acid is applied to the surface of a polished vertical section where the spicules may be observed to lie horizontally, and the part then subjected to gentle edulcoration with water, more or less of the spicules is left in relief on the surface, which, although in a friable state, as in *Pharetrospongia Strahani* when treated in a similar manner, seems to indicate a lingering remnant of their original siliceous composition.

Dysidea antiqua, n. sp. (Pl. X. figs. 7-9.)

Siliceous fossil. Small, massive, globular, sessile, reticulate (fig. 7). Surface uniformly reticulate (fig. 7, *a*), being a continuation of the internal structure, which is composed of massive reticulation (fig. 8). Fibre of reticulation about 1-96th inch in diameter; interstices about 3-48ths inch wide; com-

posed of a heterogeneous assemblage of sand and fragments of various sponge-spicules, together with what appears to be the siliceous globules of a *Geodia* and the branches of a lithistid sponge-spicule (figs. 8, *d*, and 9, *b*); but as the former is sometimes evidently botryoidal chalcedony, and the latter, from its frequency, may be a fibrous form of the same mineral, it is not safe to assume that these two forms were ever organic. Size of largest and best-formed specimen about half an inch in diameter (fig. 7).

Hab. Marine, in company with *Hyalonema Smithii.*

Loc. Upper thin beds of Lower Carboniferous Limestone, Cunningham Baidland, Dalry, Ayrshire, S.W. Scotland.

Obs. From the structure and composition of the reticulated fibre of which this fossil is composed, it may fairly be inferred to have been a sponge belonging to my order Psammonemata, probably of the family Hircinida and 16th group, viz. Arenosa; even now, from its appearance, it might almost be mistaken for a living *Dysidea* if on the rocks where the latter grows. There are several specimens, of which the largest and most perfect is that above described. Having directed a stream of water over it for some time, the material thus washed off was mounted in balsam, which presents, on microscopic examination, fragments of a variety of spicules, together with grains of quartzose sand, from which a few of the former have been figured *to scale* for illustration (fig. 9, *a*).

Rhaphidhistia vermiculata, n. sp. (Pl. IX. figs. 15–19.)

Siliceous fossil. Laminiform, parasitic on a species of (?) *Hydractinia* (fig. 15). Composed of acerate, vermicular spicules lying confusedly together on the surface of the fossil *Hydractinia* (fig. 16, *a*), which consists of a convex, subcircular, depressed mass of more or less erect, conical, columnar processes, sometimes unequally bifurcate at the apex, rising from a reticulate structure of the like nature (fig. 16), based on a continuous membranous attachment now lapidified (fig. 16, *c c*), about half an inch in horizontal diameter, which is the size of the superincumbent mass. Processes about 1-12th inch high by about 3-48ths inch wide at the base, composed of chalcedony with a saccharine crystallization on the surface (fig. 17) and a central axial hollow closed at the summit (fig. 16, *e*, *b*), covered in some instances with the layer of vermiculate spicules above mentioned, one end *alone* of each of which is visible on account of the other being hidden beneath its neighbours (fig. 18). Spicule smooth, apparently acerate, fusiform, vermiform, and abruptly pointed at each end (fig. 19); about 1-900th inch in diameter and about 1-90th

inch long, which is that of the longest *exposed* portion. Thickness of the layer inappreciable, extent depending on the quantity of the *Hydractinia* covered by it.

Hab. Marine, in company with *Hyalonema Smithii.*

Loc. Upper thin beds of Lower Carboniferous Limestone, Cunningham Baidland, Dalry, Ayrshire, S.W. Scotland.

Obs. From the general form and reticulate structure of this fossil (fig. 16) it appears to be more like a species of *Hydractinia* than any thing else, subsequently overgrown by the layer of vermiform spicules mentioned. If the whole belonged to the sponge, then it was wholly one, and not parasitically overgrown by the layer of sponge-spicules, which now form, on the columns covered by them, a continuation of the subjacent material (chalcedony). But, out of several specimens, as there are as many without as with this covering, while the columns are hollow and not solid, it seems very likely that *Rhaphidhistia vermiculata* was a parasitic laminiform sponge very much like *Hymeraphia vermiculata*, Bk.; but the large erect pin-like spicules of the latter do not appear to be present. There are many minute recent sponges, however, that are laminiform without the large erect pin-like spicule which characterizes Dr. Bowerbank's suborder *Hymeraphia*, some of which I may hereafter have to describe under the generic name *Rhaphidhistia*.

If this was a *Hydractinia* parasitically covered by the sponge, then it was probably a calcareous one which subsequently became chalcedonized and finally encroached upon by calcite; for many of the conical processes are as much eroded by rhombohedral excavation as the spicules of *Hyalonema Smithii* already mentioned; while this is also the case with many of the minute chalcedonized *shells* which Dr. Millar sent me from the disintegrated or "rotten" limestone, wherein there can be no doubt that the shell was calcareous in the first instance. Hence there is yet much in palæontology that requires elucidation by the chemist.

EXPLANATION OF THE PLATES.

Plate IX.

Fig. 1. *Hyalonema Smithii*, Y. & Y. Fragment of cord imbedded in Encrinital Limestone, natural size. *a*, upper; *b*, lower end.

Fig. 2. The same. Transverse section of the upper end, nat. size.

Fig. 3. The same. Fragment of anchoring end of cord-spicule; lateral view. *a*, view of free end; *b*, view of shaft side. × 2.

. 4. The same. Magnified, *in situ*. *a*, fragment of anchoring end.

. 5. The same. More magnified lateral view, to contrast with the following form.

Fig. 6. ? The same. Anchoring end of cord-spicule, with four arms opposite and much recurved; double sagittate.

Fig. 7. The same. Fragment of surface of body, showing, *a a*, "nail-like" spicules *in situ*, and, *b b*, fenestral openings. × 2. [N.B. In this figure the arms, which appear to have been broken off or absent, have sunk beneath the surface.]

Fig. 8. The same. "Nail-like" spicule of the most regular form. × 3.

Fig. 9. The same. Lateral view of nail-like spicule, showing the constriction at the fixed ends of the arms respectively. × 3.

Fig. 10. ? The same. Stelliform nail-like spicule with smooth and tubercled arms respectively. *a*, smooth or small form; *b*, large, matured, or tubercled form. × 3.

Fig. 11. ? The same. Double stelliform nail-like spicule. *a*, small form; *b*, large or matured form; *c c*, stelliform head in *a* and *b* respectively; *d d*, arms respectively: × 3. *e*, more magnified view of head, showing trifurcation of a lateral spine of stelliform head and tubercles over central one.

Fig. 12. ? The same. Simple sexradiate spicule.

Fig. 13. The same, to show grooving. Magnified view of a few of the cord-spicules *in situ*. Transverse section. *a a*, two single-grooved spicules together, the largest about 3-48ths inch in diameter; *b*, more magnified view of a transverse section of a single-grooved cord-spicule; *c*, the same of a four-grooved spicule; *d*, the same of a thirty-two-grooved spicule; *e*, lateral view of a fragment of the latter. All × 16.

Fig. 14. The same. Fragments of the siliceous spicule encroached upon by calcite subsequently redissolved and leaving excavations. *a*, lateral view of a fragment of a cord-spicule presenting a few excavations; *b*, end view of a fragment presenting many excavations, extending to the centre; *c*, lateral view of a fragment rendered shapeless by being fretted out by general excavation.

Fig. 15. *Rhaphidhistia vermiculata*, n. sp. ? On a species of *Hydractinia*. Upper view. × 2.

Fig. 16. The same. Fragment of the *Hydractinia*, much magnified, to show:—*a*, layer of *Rhaphidhistia* on, *b b*, conoid columns and reticulate structure of *Hydractinia*, based on, *c c*, membranous expansion, now lapidified; *d*, truncated fibre of *Hydractinia*; *e*, truncated column, showing axial cavity; *f f f*, interstices of fibre.

Fig. 17. The same. Conoid column incipiently bifurcated, much magnified, to show the absence of the layer of spicules.

Fig. 18. The same. Conoid column, much magnified, to show presence of the layer of spicules.

Fig. 19. The same. Probable form of entire spicule.

N.B. The above are all *siliceous* fossils.

Plate X.

Fig. 1. *Pulvillus Thomsonii*, n. sp. (Calcareous.) Upper view. *a*, central excavation, presenting the broken ends or transverse sections respectively of the spicules (fig. 6). Half the natural size.

Fig. 2. The same. Vertical section through the centre, showing:—*a*, upper or large excavation; *b*, lower or smaller excavation; *c*, ? stem or pedicle in smaller excavation; *d d*, granules of whitish-brown calcite, of which the fossil is chiefly composed, presenting more or less longitudinal sections of the bundles of spicules, all tending to a vertical direction; *e e e*, heterogeneous sandy material, vein like between the granules in the upper, replaced by white

calcite in the lower part, widening towards the upper part, indicative of their having formed portions of the excretory canal-system. Half the natural size.

Fig. 3. The same. Portion of the lower surface, including the smaller excavation and stem-like process. *a*, excavation; *b*, stem-like process. Half the natural size.

Fig. 4. The same. Separate granule of calcite, much magnified, to show more or less longitudinal sections of spicules in it. Diagram. Spicules on the scale of 1-48th to 1-1800th inch. *a*, calcite; *b*, spicules, variable in length and transverse diameter.

Fig. 5. The same. Example of the staple form of a perfect spicule found in the heterogeneous sandy material filling the interstices between the "granules" near the surface. Scale 1-48th to 1-1800th inch.

Fig. 6. The same. Portion of the surface of the larger excavation, showing the broken ends or transverse sections of the spicules (fig. 1, *a*). *a*, ends on a level with the surface; *b*, ends protruding. Scale of spicules 1-48th to 1-1800th inch.

Fig. 7. *Dysidea antiqua*, n. sp. (Siliceous.) Showing general form of most perfect specimen, and portion of reticulated surface. × 2. *a*, portion of reticulated surface.

Fig. 8. The same. Portion of the reticulated structure, much magnified, showing.—*a a*, the fibre composed of heterogeneous material; *b b*, the interstices; *c*, fragments of cylindrical spicules in the fibre; *d*, fragments of lithistid-like fibre. Diagram.

Fig. 9. The same. A few of the fragmentary spicules washed off the fibre and mounted in balsam, to show that the fibre is heterogeneously composed. *a*, smallest four-armed anchoring-spicule seen; *b*, (?) branch of lithistid sponge-spicule. Scale 1-96th to 1-6100th inch.

Budleigh-Salterton,
28th November, 1877

XVI.—*Notes on new and little-known* Mantidæ. By Prof. J. Wood-Mason, Deputy Superintendent, Indian Museum, Calcutta.

1. *Euchomena thoracica.*

Mantis (Thespis) thoracica, De Haan, Orthopt. Orient. p. 94, ♀.
Phasmomantis? thoracica, Saussure, Mélanges Orthopt. i. 3e fasc. p. 192 (44); ibid. p. 403 (279).
Fischeria thoracica, Saussure, *op. cit.* ii. 4e fasc. p. 58.
Euchomena? macrops, Saussure, *op. cit.* i. 3e fasc. p. 196 (48), ♂.

"*Femina.* Alis abbreviatis, hypothoracem non superantibus, immaculatis; prothorace longissimo, integro; femoribus anticis intus pallidis, fasciis tribus fuscis; pedibus posticis nigro marmoratis; cercis analibus cylindricis. Long. proth. 2″; abdom. 15‴; elytr. 6‴. *Hab.* ?"

Hab. A specimen of the female was captured several years ago by my native collector in Johore, Malay peninsula; and

another, which has been independently identified by Prof. Westwood as the *T. thoracica* of De Haan, exists in the Hopeian collection at Oxford.

The following are the measurements of the specimen (dried) from Johore:—

Total length of body 106 millims.; height of head 5, breadth of head 8; length of prothorax 58, of which the neck is 8·33, breadth of prothorax at narrowest part, just behind dilatation, 2·25; length of meso- and metanotum together 13, of tegmina 12, of abdomen 31; of fore coxa 22·5, of femur 26, of its unarmed part 14·5; of intermediate femur 25, of tibia 23; of posterior femur 31, of tibia 32.

The fore tibiæ have 7 teeth on the outer edge, the base of which is unarmed, and 14 on the inner; the abdomen is depressed and rather broadly fusiform, with its posterior segments graduated so as to have a serrated appearance in this part; and the supraanal plate is short, broader than long, and rounded off at the extremity.

This species cannot be the female of *Fischeria gigas* as suggested by De Saussure, but is, in all probability, that of *Euch.? macrops*, Sauss., from Cochin China.

Euchomena heteroptera, *Euch.? macrops* ♂, and *Euch. thoracica* ♀ all have the inner face of the fore femora triply banded with fuscous, and all belong to the same fauna.

A fuller description with figures will be published hereafter.

2. *Fischeria laticeps.*

Fischeria laticeps, Wood-Mason, A. & M. N. H. 1876, 4th ser. vol. xviii. p. 337, ♂.

♀. Ocelli small, seated on a slightly elevated area, not on the ends of the rays of a triradiate elevation as in the male; the lower one circular, the two upper ones oval.

Pronotum with a very faint raised median line, on either side of which are a few small polished granules; its margins throughout minutely denticulate, the denticles blunt and polished; the sides of the disk of its posterior lobe bent down at an obtuse angle to the median portion.

Organs of flight abbreviated, in repose barely reaching so far as to the end of the basal third of the first abdominal segment. Tegmina opaque, semicoriaceous: the lower surface richly coloured, the marginal field dull luteous, the basal portion of the discoidal and the axillary field stone-coloured, with a faint tinge of red-violet, the rest of the former occupied by a great oval blotch of dark brown with amethystine reflections, in the centre of which is a large transversely oval cream-coloured ocellus, with minutely jagged edges: the upper sur-

face is of the same sober colour as the body, with a patch of lighter coloration coinciding with the anteapical cream-coloured ocellus on the under surface; the anal area very salient, black, with green reflections (dark brown by transmitted light). Wings small, forming a quadrant of a circle all but unbroken by anal emargination; the anterior field opaque, dull luteous, with a large anteapical blotch of brown, ocellate or broadly banded with yellow; the posterior field black, with green reflections (dark brown by transmitted light), lined with hyaline along the transverse veinlets.

Colour of the body luteous grey, finely mottled with pale impure olive-green.

Length of body 102 millims.; height of head 4·75, breadth of head 9·8; length of prothorax 34, of which the neck is 9·6, breadth of prothorax at supracoxal dilatation 4·6; length of abdomen 51, of cerci 12·75, of tegmina 16; width of marginal area of tegmina 1; length of anterior femur 22·6, of intermediate femur 25, of posterior femur 33; of antennæ 16, or about half as long as the prothorax, or as long as the tegmina.

Another specimen obtained at the same time measures only 93 millims. in length.

Described from fresh alcoholic specimens.

Hab. ♀ ♀. Bangalore District, Mysore, obtained by Private Reedy; , Sheargaon, Kolapur state, India.

There can be no doubt that the four insects, two nymphs and two adults, recently received by me from South India, are all females of this species, though so much smaller than the male specimen described *loc. suprà cit.* In the form of the head and eyes, of the cerci and supraanal plate, of the legs, &c. they all agree perfectly with the male, differing from it in those points only in which the two sexes of other species (e. g. *F. ocellata*) of the same genus have been shown to depart from one another. These differences are the slightly stouter build, the soberer desert-form-like livery, the much-abbreviated organs of flight, these barely reaching the end of the basal third of the first abdominal segment, &c.

Specimens of both sexes of the larger race are in the Hopeian collection at Oxford; but the species is unrepresented either in the National collection or apparently in the continental collections.

3. *Hierodula notata.*

Mantis notata, Stoll, Spectres, Mantes, &c. fig. 49, ♀ (1789).
Hierodula notata, Saussure, Mélanges Orthopt. ii. 3e fasc. p. 280, pl. v. fig. 31.

♀. Total length 67 millims.; length of prothorax 23,

breadth of prothorax at dilatation 6·3; length of meso- and metanotum taken together 17, of abdomen 21·5, of tegmina 48; breadth of tegmina 16, of marginal area 4·75.

Alcoholic specimen.

Hab. Ceylon (*F. M. Mackwood*).

4. *Hierodula birivia.*

Mantis birivia, Stoll, Spectres, Mantes, &c. pl. ix. fig. 31 (1787).
Stagmatoptera birivia, Saussure, Mém. Orth. Mexique, &c. tom. ii. p. 89, 4, fig. 8, ♀.
Hierodula birivia, Saussure, Mél. Orthopt. ii. 4e fasc. p. 41.

♀ ♀. Total length 80–87 millims.; height of head 8·5–9·5, breadth of head 11·33–12; length of prothorax 29–32, breadth of prothorax at dilatation 8·6–9·2; length of abdomen 30–33, breadth of abdomen 18; length of mesonotum and metanotum taken together 18·5–20, of tegmina 49–53, from base to stigma 18–20, of stigma 2; breadth of tegmina 19–20·5, of marginal area 5·6–6.

Alcoholic specimens.

In the larger specimen (from Madras) the discoidal vein emits three branches in the right wing and five in the left; in the smaller (from Bangalore) three in the right and two in the left; while in M. de Saussure's specimen it is three-branched in both wings.

5. *Hierodula taprobanæ*, n. sp.

♀. Allied to the preceding, but differing:—in its stouter prothorax, the lamellar lateral margins of which are broader and extend, narrowing gradually as they go, from the supracoxal dilatation to the base of the segment; in its broader and more coriaceous tegmina, the anal area of which alone is membranous; in the form of its facial shield, which is higher (longer) than broad, instead of broader than high, the upper margin of which is obtuse-angled instead of arcuate, and the surface of which is marked by two obtuse vertical ridges on its upper half; and in the armature of the anterior angle of the fore femora, which is furnished, as in *H. notata*, with six or seven large, stout, and blunt conical spines only. The apical third of the tegmina, which in *H. birivia* are uniform green, is stained brownish yellow. The discoidal nervure of the wings is three-branched. The fore tibiæ have 14–15 teeth on the inner edge, and 11 on the outer.

Total length of body 83 millims.; height of head 9·6, breadth of head 11·6; length of prothorax 30·6, breadth of prothorax at dilatation 11; length of meso- and metanotum taken together 20·5, of abdomen 31; greatest breadth of

abdomen 20; length of tegmina 56, breadth of tegmina 23, of their marginal area 8; length of stigma 3·75; of fore coxa 21·5, femur 24·3; of intermediate femur 21, tibia 18; of posterior femur 25, tibia 25.

Dried specimen.

Hab. Ceylon. Communicated by Mr. F. M. Mackwood, of Colombo.

6. *Hierodula trimacula.*

Hierodula trimacula, Saussure, Mélanges Orthopt. i. 3e fasc. p. 82, pl. v. fig. 29, ♀.

Hab. Omán, Arabia, obtained by Colonel Miles, the British Resident at that place. The species was described from a specimen in the Paris Museum, marked "China?"

XVII.—*Revision of the* Plagusiinæ. By Edward J. Miers, F.L.S., F.Z.S., Assistant in the Zoological Department, British Museum.

The following is a synonymic list, with brief diagnoses and remarks, of the species of this small and well-defined group, which belongs to the subtribe Catometopa, or Grapsoid Brachyura, and is peculiar on account of the remarkably flattened carapace and of the position of the antennules, which are exposed in deep longitudinal clefts or sinuses of the front and are visible in a dorsal view. It contains but two genera, *Plagusia* and *Leiolophus**.

In determining and naming the species in the collection of the British Museum, I found that several of those recorded had apparently been established on insufficient grounds, and that of others the commonly received designations could not be retained; and I think it will be useful to place these observations on record, and at the same time indicate those characters which I have found most constant and reliable for distinguishing the species.

* The curious genus *Crossotonotus*, recently established by M. A. Milne-Edwards (Nouv. Archiv. Mus. Hist. Nat. ix. p. 282, 1873) for a species (*C. compressipes*) from the Samoa Islands and New Caledonia, presents many affinities with the Plagusiinæ, but cannot be referred to this group, on account of the absence of the frontal sinuses. The genus *Plagusetes*, based on a species from Chili (*P. elatus*), described by Heller in the preliminary synopsis of the Crustacea of the 'Novara' Voyage (Verh. zool.-bot. Gesell. Wien, xii. p. 522, 1862), is not mentioned in his final report, but seems to have been based on specimens subsequently referred to *Acanthocyclus Gayi*, a genus belonging to the Cancroidea, but possessing some affinities with the Plagusiinæ.

The crustaceans of this group are found in nearly all the tropical and warmer temperate seas of the globe.

Plagusia.

Plagusia, Latr. (part), Gen. Crust. et Ins. i. p. 33 (1806); M.-Edw. (part), Hist. Nat. Crust. ii. p. 90 (1837); Ann. Sci. Nat. (sér. 3) Zool. xx. p. 178 (1853), &c.
Philyra (subgen.), De Haan, Faun. Japon. Crust. decas ii. p. 31 (1835).

Outer maxillipeds with the third or merus joint well developed, as broad as the preceding joint. (Male genital appendages of the first pair without a terminal claw.)

§ 1. *Merus joint of the ambulatory legs with a terminal and subterminal spine on its upper margin.*

Plagusia tuberculata.

Plagusia squamosa, Lamarck, Hist. An. sans Vert. p. 246 (1818); M.-Edw. Hist. Nat. Crust. ii. p. 94 (1837), nec Herbst.
Plagusia tuberculata, Lamarck, *l. c.* p. 247 (1818); Latr. Encycl. Méth. x. p. 146 (1825), Atlas, Crust. pl. cccv. fig. 1 (1818); M.-Edw. Hist. Nat. Crust. ii. p. 94 (1837).
Plagusia orientalis, Stimpson, Proc. Ac. Nat. Sci. Phil. p. 103 (1858); Ann. Lyc. Nat. Hist. New York, vii. p. 231 (1860).

The carapace is covered with numerous small, often depressed tubercles, each of which is bordered by a fringe of short stiff hairs. The lobe above the bases of the second and third ambulatory legs is prominent, subacute, and not dentated. The terminal segment of the male postabdomen is broadly semioval and rounded at its distal extremity.

This species is probably common and widely distributed throughout the whole Indo-Pacific region.

Specimens are in the British-Museum collection from the Mauritius (*Leach's coll.*), Red Sea (*Burton*), Australia (*Gould*).

It has been recorded by Milne-Edwards from the Indian Ocean; and by Stimpson (under the name of *P. orientalis*) from Hong Kong, the Hawaiian Islands, and Cape St. Lucas in California. Probably also the specimens recorded by Heller (Voy. Novara) from the Red Sea, Nicobars, Madras, and Sydney belong here.

This species was first distinctly characterized by Stimpson under the name of *P. orientalis*; but it would appear that Lamarck's earlier name of *P. tuberculata* must be adopted for it. His specimen was from the Mauritius, and is referred by Milne-Edwards to his *Plagusia squamosa*.

Plagusia depressa.

? *Cancer depressus*, Fabr. Syst. Ent. p. 406 (1775); Ent. Syst. Suppl. p. 343 (1798).
? *Cancer squamosus*, Herbst, Naturg. Krabben u. Krebse, i. p. 260, pl. xx. fig. 113 (1790).
Plagusia depressa, Say, Journ. Ac. Nat. Sci. Phil. i. p. 100 (1815).
Plagusia Sayi, DeKay, Zool. N.Y. Fauna, vi. Crust. p. 16 (1844); M.-Edw. Ann. Sci. Nat. (sér. 3) Zool. xx. p. 179 (1853); Stimpson, Ann. Lyc. Nat. Hist. New York, vii. p. 64 (1859).
Plagusia squamosa, Latr. Encycl. Méth. x. p. 145 (1825); Dana, U.S. Expl. Exp. xiii. Crust. i. p. 368 (1852).
Plagusia gracilis, Saussure, Mém. Soc. Phys. et Hist. Nat. Genève, xiv. p. 449 (1858).

This species very closely resembles the preceding, but is distinguished, as Mr. Stimpson, in his "Notes on the North-American Crustacea," has pointed out, by the following characters. There is a series of about six prominent acute tubercles arranged in the form of an arc across the front of the gastric region; and the lobe above the bases of the second and third ambulatory legs is broader and regularly dentated. The terminal segment of the postabdomen in the male is, I may add, narrower, with the sides more distinctly convergent to the distal extremity.

Hab. This species inhabits what may be denominated, in contradistinction to the *Indo-Pacific*, the *Atlantic* region. Specimens are in the British Museum from the Tortugas, Garden Key (*Smithson. Inst.*), Jamaica (*Gosse*), Madeira (*Rev. R. T. Lowe*, *Dr. Halley*, *Blewitt*), Brava Island (*Rev. R. T. Lowe*), St. Helena (*Melliss*).

It is recorded from Charleston Harbour, South Carolina (*Gibbes*), and Brazil (*Lichtenstein*, fide *Latreille*).

In one adult specimen from Madeira in the Museum collection the teeth of the superior lobes of the ambulatory legs are nearly obsolete; but even in this instance, in their broader and more truncated apices, they differ from the same lobes in the preceding species.

On account of the habitat ("*in mare Mediterraneo, Americano*"), the *Cancer depressus* of Fabricius, Syst. Ent. p. 406 (1775), and Ent. Syst. Suppl. p. 343 (1798), probably belongs to this species; and I adopt his name for it the more readily as Say, in 1815, employed it for specimens from the coast of the United States. The figure of Herbst's *Cancer squamosus* distinctly represents the lobe at base of the ambulatory legs as dentated, and hence is to be referred to this species; but as the habitat is given as "Ost-Indien," there can be little doubt that Herbst, like most later authors, failed to appreciate its distinctive characteristics, and united under one name the Atlantic and Indo-Pacific forms.

Von Martens remarks (Arch. f. Naturg. xxxviii. p. 112, 1872) that he found it impossible to find constant characters to separate specimens (referred by him to *Plagusia squamosa*) from Cuba, Brazil, Madeira, and the Red Sea. As, however, he had seen only a male and a female from the last-mentioned locality, and had seen no specimens of the *Plagusia orientalis* of Stimpson, it is probable that he may have overlooked the characters derived from the superior lobes of the ambulatory legs and terminal postabdominal segment in the male (*vide* also 'Preuss. Exped. nach Ostasien,' zoolog. Theil, i. p. 22, 1876).

Plagusia immaculata.

Plagusia immaculata, Lam. Hist. An. sans Vert. v. p. 247 (1818).
Plagusia depressa, Latr. Encycl. Méth. x. p. 145 (1825); M.-Edw. Hist. Nat. Crust. ii. p. 93 (1837); Ann. Sci. Nat. (sér. 3) Zool. xx. p. 179 (1853); Dana, U.S. Expl. Exp. xiii. Crust. i. p. 369 (1852); Stimpson, Proc. Ac. Nat. Sci. Phil. p. 103 (1858); nec *Cancer depressus*, Fabricius.

In this species the carapace is more convex than in either of the preceding, the tubercles much depressed, quite naked, often almost obsolete upon the gastric and cardiac regions. The lobe above the bases of the second and third pairs of ambulatory legs is small and not dentated.

The series in the British-Museum collection includes specimens from Ceylon (*Holdsworth*), Torres Straits (*Jukes*), Philippine Islands (*Adams*), Timor Island (*Rayner*), Louisiade archipelago (*Macgillivray*), Sandwich Islands, Honolulu (*Lieut. Strickland*).

According to Stimpson, specimens found on the west coast of Central America by Capt. Dow belong to this species. It inhabits the seas of China, New Guinea, and the Indian Ocean (*M.-Edw.*); the islands of Loochoo and New Ireland (*Stimpson*); the Straits of Sunda (*Dana*), Nicobars, Shanghai, and Punipet (*Heller*).

Milne-Edwards has pointed out the unsuitability of the name of *P. depressa* for this species, which is the most convex of any of the Plagusiinæ; and as it is not the *Cancer depressus* of Fabricius, nor (probably) of Herbst, it appears necessary to adopt Lamarck's name of *P. immaculata*, which is quoted as a synonym of the species by Milne-Edwards (Hist. Nat. des Crustacés).

I transcribe the following MS. note of the colours (when fresh) of a specimen found on the ship's bottom, off Redscar Point, in the Louisiade archipelago, and now in the British-Museum collection:—

"Colour pale green, mottled with reddish brown. Tarsi

above dark purplish brown, with small markings of very pale bluish green. Carapace mottled and washed with pale dirty green, dark reddish brown, and straw-colour, with a few orange dots." This specimen, in its dried state, is of a nearly uniform dull chestnut-brown.

M. Brocchi (Ann. Sci. Nat. sér. 6, Zool. ii. p. 80, pl. xix. figs. 168–170, 1875) figures the male genital appendages of specimens both of this species and of *P. Sayi* from Guadeloupe. In the specimens referred by this author to *P. depressa* the first pair of genital appendages are of peculiar shape, constricted in their subterminal half, and with the distal extremity of an oval form (fig. 170); whereas in male individuals I have examined this pair of appendages scarcely differ in form from those of *P. squamosa*; that is to say, they are, as in the Atlantic species, strongly contorted and truncated at the extremity.

Plagusia speciosa.

Plagusia speciosa, Dana, Proc. Ac. Nat. Sci. Phil. v. p. 252 (1851); U.S. Expl. Exp. xiii. Crust. i. p. 369, pl. xxiii. fig 9 (1852); M.-Edw. Ann. Sci. Nat. (sér. 3) Zool. xx. p. 179 (1853).

This species is distinguished from all its congeners by having only three teeth upon the antero-lateral margins of the carapace, including the outer orbital tooth.

Hab. Paumotu archipelago, Waterland Island (*Dana*).

Only a carapace of this species is known. The disposition of the tubercles on the dorsal surface, as described by Dana, differs somewhat from that usual in *P. squamosa*.

Plagusia glabra.

Plagusia glabra, Dana, Proc. Ac. Nat. Sci. Phil p. 252 (1851); U.S. Expl. Exp. xiii. Crust. i. p. 371, pl. xxiii. fig. 10 (1852); M.-Edw. Ann. Sci. Nat. (sér. 3) Zool. xx. p. 179 (1853).

Is described by Dana as having the carapace smooth and glabrous, antero-lateral margin quadridentate, front above obliquely subcristate, not spinigerous. Anterior legs of male very short, part of hand preceding fingers shorter than its height, granulate above, smooth externally and not costate; wrist nearly smooth. Third joint of eight posterior legs smooth. Third joint of outer maxillipeds quadrate, slightly oblong.

Hab. New South Wales (*Dana*), Australia (*coll. Brit. Mus.*).

The male specimen described by Dana measured about 9 lines. The specimen in the British-Museum collection is a female of much larger size (1 inch 7 lines), and is closely

speckled with red. There is an irregular granulated ridge on the upper surface of the wrist, and an abrupt prominence behind the upper orbital margin, which is beaded. The buccal organs are wanting. This species is at once distinguished by the smooth and naked carapace, less deeply incised frontal sinuses, and the form of the hands, and appears to establish the transition from the Plagusiinæ to the Grapsinæ, through *Cyrtograpsus*.

§ 2. *Merus joint of the ambulatory legs with a series of spines on its upper margin (carapace almost entirely destitute of tubercles).*

Plagusia chabrus.

Cancer chabrus, Linn. Mus. Lud. Ulr. p. 438 (1764); Syst. Nat. p. 1044 (1766).
Plagusia tomentosa, M.-Edw. Hist. Nat. Crust. ii. p. 92 (1837); Ann. Sci. Nat. (sér. 3) Zool. xx. p. 178 (1853).
Plagusia capensis, De Haan, Faun. Japon. Crust. p. 58 (1835).
Plagusia chabrus, White, Ann. & Mag. Nat. Hist. xvii. p. 497 (1846).

Carapace covered with a very short close pubescence, and without tubercles. Front armed above with two small spines, and with a series of small tubercles on its anterior margin. Anterior legs tuberculated. Lobes above the bases of the second and third ambulatory legs terminating in a short spine.

Specimens of this species are in the British Museum from the Cape of Good Hope (*Sir A. Smith, Capt. Carmichael, Dr. P. Hahn*), New Zealand (*Dr. Sinclair*), and Tasmania, near George Town (*R. Gunn*).

It has been recorded from New South Wales (*Dana*), Chili (*M.-Edwards*).

It is probable that the species briefly characterized by Milne-Edwards (Ann. Sci. Nat. sér. 3, Zool. xx. p. 178, 1853) under the name of *P. Gaimardi*, from Tongatabu, is only a variety of the above.

The first pair of genital appendages in the male are not twisted as in *P. squamosa*, and their inferior margins are thin and sharp-edged; they are sometimes very slightly constricted towards the distal extremity, which is obtuse and subtruncated.

Plagusia dentipes.

Grapsus (Plagusia) dentipes, De Haan, Faun. Japon. Crust. decas 2, p. 58, pl. viii. fig. 1 (1835).
Plagusia dentipes, M.-Edw. Ann. Sci. Nat. (sér. 3) Zool. xx. p. 178 (1853); Stimpson, Proc. Ac. Nat. Sci. Phil. p. 103 (1858).

This species is distinguished from the preceding by having

a group of tubercles on the hepatic region of the carapace, near the base of the outer orbital tooth; and the spines upon the upper margins of the merus joints of the ambulatory legs are much stronger.

Hab. Japan (*De Haan*), Simoda (*Stimpson*).

I have seen no specimens.

LEIOLOPHUS.

Acanthopus, De Haan, Faun. Japon. Crust. p. 29 (1835); M.-Edw. Ann. Sci. Nat. (sér. 3) Zool. xx. p. 180 (1853); nom. præoccupatum.

Leiolophus, Miers, Cat. New-Zeal. Crust. p. 46 (1876).

Outer maxillipeds with the merus joint very small and much narrower than the preceding joint. (Carapace with smooth naked ridges on its upper surface, but without numerous tubercles. Merus joints of the ambulatory legs with a series of spines on their upper margins. Male genital appendages of the first pair not twisted, with a terminal claw.)

Leiolophus planissimus.

Cancer planissimus, Herbst, Naturg. Krabben und Krebse, iii. pl. lix. fig. 3 (1804).

Plagusia serripes, Lam. Hist. An. sans Vert. p. 247 (1818).

Plagusia clavimana, Desm. Consid. Crust. p. 127, pl. xiv. fig. 2 (1825); M.-Edw. Hist. Nat. Crust. ii. p. 92 (1837); Atlas in Cuvier, R. A. pl. xxiii. fig. 3.

Acanthopus planissimus, De Haan, Faun. Japon. Crust. p. 30 (1835); Dana, U.S. Expl. Exp. xiii. Crust. p. 372 (1852); M.-Edw. Ann. Sci. Nat. (sér. 3) Zool. xx. p. 180 (1853).

Acanthopus Gibbesi, M.-Edw. Ann. Sci. Nat. *t. c.* p. 180 (1853).

Leiolophus planissimus, Miers, Cat. New-Zeal. Crust. p. 46 (1876).

Hands in the male strong; the palms compressed and considerably dilated, much broader than the wrist, not sulcated on their upper margins. Greatest width of the abdomen of the male exceeding its length to the base of the last segment.

Specimens are in the British Museum from Mauritius (*Lady F. Cole*), Torres Straits (*Jukes*), Keeling or Cocos Island (*Lieut. Burnaby*), Pacific Ocean (*Smithsonian Inst.*), Madeira (*Rev. R. T. Lowe*), Jamaica (*purchased*).

It is abundant in the Polynesian archipelago, having been recorded from islands in the Paumotu, Society, Samoan, and Hawaiian groups (*Dana*), also from Cape St. Lucas and the coast of Florida, Key Biscayne (*Stimpson*).

In male specimens of large size from Madeira, the genital appendages of the first pair differ slightly from those of *L. abbreviatus* and Brocchi's figure (*l. c.* fig. 171), in being slender, more curved, and narrower in the middle than at either extremity.

Unfortunately, in the British-Museum copy of Herbst's work, the concluding part, containing the description and figure of his *C. planissimus*, is wanting; I have therefore not been able to verify the reference, which is quoted from Milne-Edwards.

Leiolophus abbreviatus.

Acanthopus abbreviatus, Dana, Proc. Ac. Nat. Sci. Phil. p. 252 (1851); U.S. Expl. Exp. xiii. Crust. i. p. 373, pl. xxiii. fig. 11 (1852); M.-Edw. Ann. Sci. Nat. (sér. 3) Zool. xx. p. 181 (1853).

Hands in the male small, the palm not dilated, and longitudinally sulcated on the upper margin in both sexes. Abdomen of the male rather narrow, its greatest width not quite equalling its length to the base of the last segment.

There are specimens in the British Museum from the Mauritius, Moluccas, Gilolo (*Adams*), Philippines, Guimaras (*Cuming*), Fiji Islands (*H.M.S. 'Herald'*).

Most of the specimens in the collection are females. In one male adult example, whose genital appendages I have examined, these organs are exactly of the form figured by Brocchi (*l. c.* fig. 171) in specimens referred by him to *L. planissimus.*

Leiolophus pilimanus.

Acanthopus pilimanus, A. M.-Edw. Nouv. Archiv. Mus. Hist. Nat. ix. p. 300, pl. xiv. fig. 5 (1873).

This species, in the dilated hands of the male, resembles *L. planissimus*, but is distinguished from it and from all its congeners by the existence of a large patch of thick hair upon the inner surface of the palms. There is a row of small spines upon the inner margins of the antennulary cavities. The abdomen is also said to be narrower than in *L. planissimus.*

Hab. New Caledonia (*M. Balansa*).

The male only is known of this large species. I have seen no specimens.

The characters assigned by M. Milne-Edwards to his *Acanthopus affinis* (Ann. Sci. Nat. sér. 3, Zool. xx. p. 180, 1853) from the Sandwich Islands, and *A. tenuifrons* (*l. c.*) from the Marquesas, do not appear to me to be of specific importance.

The *Leiolophus spinosus* (*Plagusia spinosa* of M'Leay, in Smith's Zool. S. Africa, Annulosa, p. 66, 1838) would seem to be a distinct species, if the character "*clypei lateribus bidentatis*" be correct. It is stated by its author to be nearly allied to the *L. planissimus* (*P. clavimana* of Desmarest), with which it is united by Krauss (Südafrik. Crust. p. 42, 1843).

XVIII.—*Entomological Notes bearing on Evolution.* By Raphael Meldola, Sec. Ent. Soc.

In 1871, when working at the subjects of "mimicry" and "protective resemblance," Mr. Darwin was so good as to send me for perusal a letter which he had received from Fritz Müller, then in St. Catharina, Brazil. As this letter contains many entomological observations of interest, I have thought it advisable to take steps to secure their being placed upon record in a permanent form; and, with the permission of Mr. Darwin, I have selected extracts which I beg to make known in the present paper, together with other observations from various sources which tend to throw light on subjects connected with the descent theory

Sounds made by Butterflies.

Mr. Darwin has already recorded * the sound produced by the South-American butterfly, *Ageronia feronia*, which is stated to make "a noise like that produced by a toothed wheel passing under a spring catch, and which could be heard at the distance of several yards." With reference to the object of this sound Mr. Darwin states †, "At Rio de Janeiro this sound was noticed by me only when two were chasing each other in an irregular course, so that it is probably made during the courtship of the sexes." With regard to this insect Fritz Müller writes, "I told you some time ago that I had not yet seen it here; but lately I have caught two specimens belonging to two species, and I have seen in the collection of a friend of mine a third specimen of a third species. One of these specimens had been observed for many days by my children flying around some orange-trees near my house; it frequently alighted on the putrefying fruit on the ground, on the juice of which it seemed to feed. My children never heard any noise produced by it, neither did I; and this seems to confirm your view that the noise is made only during the courtship of the sexes."

*I may add that our common *Vanessa Io* is stated to make a faint hissing sound‡; but the precise conditions under which this noise is produced require further observation.

* Journal of Researches, 1845, p. 33. On the sound-producing apparatus see E. Doubleday in Proc. Ent. Soc., March 3, 1845. See also a paper by Mr. A. H. Swinton, "On an Organ of Hearing in Lepidoptera," Ent. Mo. Mag., Nov. 1877.

† Descent of Man, 2nd ed. p. 307.

‡ Rev. J. Greene, Trans. Ent. Soc. new series, vol. ii. p. xcviii, and Mr. Hewitson, ibid. vol. iv. p. ii. The sound-producing structure has been figured by Mr. Swinton, Ent. Mo. Mag., Jan. 1877.

Display of Colour by Lepidoptera.

With reference to the display of colour by butterflies and moths, Mr. Darwin has already * recorded the case of a species of *Castnia* which possesses ornamented hind wings and displays them, while other species with plain hind wings do not display them †. Fritz Müller adds the following interesting case:—"I observed a curious little fact with our *Hesperidæ*. Most of them are of a dull brownish colour; but there are some in which the wings have a more or less vivid blue tint either on the upper or on the lower surface. Now the former when alighting on a flower always hold their wings expanded in a *horizontal plane*, while those of the latter are folded *vertically*, so that in either case the blue surface is exposed to view." Without further observation it cannot be assumed in this case that the colour is displayed as a sexual attraction, since it is well known that colour is displayed for other purposes, such as for *protection*, when the colour is a signal of distastefulness (as with brightly coloured larvæ, and those species which serve as models for mimicry), or for giving resemblance to some coloured objects, such as flowers.

Insects distinguishing Colours.

The distinguishing of colours by insects has been proved in the case of bees and wasps by Sir John Lubbock's experiments. This faculty is of paramount importance to the theory of sexual selection ‡. Fritz Müller states, "Butterflies not only discover flowers by colour, but certain species even give an unmistakable preference to certain colours. Thus *Callidryas Philea* and some other species of that genus almost exclusively visit brilliant red flowers (*Canna, Salvia*). A red *Hedychium* in my garden was constantly surrounded by a multitude of *Callidryas Philea* (and of *Papilio Thoas*); and so are at present some other plants with red flowers, while they never alight on plants of the same and other genera with yellow, white, or blue flowers."

Mimicry.

It has hitherto been considered a general rule that a mimicked species is commoner than the species which mimics

* Descent of Man, 2nd ed. p. 314.

† Ibid. 2nd ed. p. 315. Mr. Darwin has called my attention to Fritz Müller's "Beobachtungen an brasilianischen Schmetterlingen," a paper which contains some further remarks bearing on the subject of display, in the October number of 'Kosmos.'

‡ 'Descent of Man,' 2nd ed. p. 317. On the attraction of *Macroglossa stellatarum* by colour, see a letter in 'Nature,' vol. xvii. p. 11, Nov. 1, 1877.

it. Fritz Müller records the following exceptions:—"There are here some exceptions to the rule that the imitating species are comparatively rare, while the imitated swarm in large numbers. Thus *Mechanitis Lysimnia* is hardly more common than the imitating *Leptalis*; and the beautiful *Papilio nephalion*, Godt., is here so rare that I have seen only two or three specimens last summer, whilst the imitating *Euterpe tereas* is by far more common. But in other parts of Brazil the numerical relations of these species may be different."

I would add, with reference to this observation, that it is quite conceivable that in certain districts external conditions may so change that a species dominant in other regions may become rare or altogether extinct, while the species which mimics it may remain unaffected. Thus *Diadema misippus*, the female of which mimics *Danais chrysippus*, is found in South America, while the model *Danais* is not *. Mr. Trimen also remarks †:—"The magnificent *Papilio Antimachus*, Drury, of which but one specimen is known to science, is very Acræïform in habit, and is possibly an instance of special modification in imitation of some gigantic *Acræa* as yet unknown or perhaps extinct." *Papilio Zalmoxis* also, as I am informed by Mr. A. G. Butler, probably mimics some unknown or extinct gigantic *Acræa*. Many cases are known in which a butterfly is obviously a mimic, but its exact model is unknown ‡. I am disposed to believe that such instances show us the process of mimetic resemblance in actual progress. For example, many species of *Elymnias* resemble species of *Euplœa*; but it is impossible to name the precise species of the last genus which in each case serves as a model. In these cases it is more reasonable to suppose that the mimicry of the *Elymnias* is in course of perfection, than to assume that the species which they imitate have become extinct. It is also

* This species (*D. misippus*) is stated to occur in Guiana on the authority of Boisduval. My friend Mr. A. G. Butler has just informed me that a large male from Formosa, in which the Danaiform characters are partially visible, has been lately added to the national collection. Here we have an interesting case in which mimetic characters originally acquired by a female butterfly are probably in course of transmission to the male.

† Trans. Linn. Soc. vol. xxvi. p. 503. I learn that probably two other specimens have been obtained since the above was written.

‡ For numerous instances of imperfect mimicry see papers by A. G. Butler:—"A Monograph of the Lepidoptera hitherto included in the Genus *Elymnias*," Proc. Zool. Soc. June 6, 1871; also on *Protogonius*, ibid. Dec. 2, 1873, and Jan. 19, 1875. Mr. Neville Goodman points out (Proc. Camb. Philos. Soc., Feb. 12, 1877) that *imperfect resemblances* are arguments in favour of the production of the phenomenon through the action of natural selection.

conceivable that a general resemblance to a protected group might in some districts be quite as efficacious as a resemblance to particular species of such a group.

As another instance bearing on the present subject I may cite *Argynnis niphe*, the female of which is a very fair mimic of *Danais chrysippus*. The former species (var. *inconstans*) ranges into Australia, while the *Danais* does not occur in that region; and what makes this case so particularly interesting is, that in Australia, where there is no model, *both sexes of the* Argynnis *are alike*, and resemble the male of the Indian form.

The degree of exactness with which mimics sometimes resemble their models has been noticed by all observers; but there are only a few recorded cases where the insects themselves have been known to be deceived. Mr. Trimen states * that the male *Danais chrysippus* has been deceived by the female *Diadema bolina.* Fritz Müller writes:—"One of the most interesting of our mimicking butterflies is *Leptalis melite.* The female alone of this species imitates one of our common white *Pieridæ*, which she copies so well that even her own male is often deceived; for I have repeatedly seen the male pursuing the mimicked species, till, after closely approaching and becoming aware of his error, he suddenly returned."

Correlation of Habit with Protective Resemblance.

Mr. Bates has already recorded the resemblance of a caterpillar (supposed to be a species of *Notodontidæ*) to a venomous snake †; and Dr. Weismann has likewise shown ‡ that the eye-like markings on *Chærocampa*-larvæ actually frightened away birds. Fritz Müller states that he "found the caterpillar of a *Papilio* which strikingly resembled the head of a venomous snake."

By referring to Mr. Bates's description it will be seen that the mimicry extended even to *attitude.* All observers have noticed how in some instances a mimicking insect *copies the flight* of its model; and such cases of correspondence between habit and resemblance are of great theoretical interest to the evolutionist. Thus Mr. Wallace has shown, in the case of the well-known "leaf-butterflies" (*Kallima*), how the insects settle on the bushes in an attitude which perfects their resemblance to dead leaves. The same observer also mentions, with respect to the stick-like *Phasmidæ*,

* Trans. Linn. Soc. vol. xxvi. p. 513.

† Ibid. vol. xxiii. p. 509.

‡ 'Studien zur Descendenz-Theorie,' part ii. pp. 100 *et seq.* This observation has been confirmed in the case of *C. elpenor* by Lady Verney (see a paper in 'Good Words,' Dec. 1877, p. 838).

that "they hang loosely about shrubs in the forest, and have the extraordinary habit of stretching out their legs unsymmetrically so as to render the deception more complete." Fritz Müller supplies the following analogous instances:—"The caterpillars of some *Papiliones* resemble fresh excrements of a bird; these caterpillars always rest on the *upper* surfaces of the leaves on which they feed, while those of some other *Papiliones* (*Nephalion*, *Polydamas*), which are not protected by some such resemblance, always hide themselves on the *lower* surfaces of the leaves."

Even among our own insects hundreds of such cases might be noted. Thus the weevils, which resemble pellets of earth, tuck in their legs and feign death when alarmed, and the stick-like geometer larvæ erect themselves stiffly from the twigs on which they rest. *Cucullia chamomillæ* and *Galeria cerella* both resemble broken splinters of wood when at rest; and I have seen these moths at the extreme ends of pointed palings, where they had erected themselves at an angle to the wood, making the resemblance to a broken-off splinter remarkably deceptive. *Calocampa vetusta* is very like a piece of broken stick when its wings are closed; and this moth has been seen hanging to a twig by one leg. *Gasteropacha quercifolia*, which, when at rest, resembles a withered leaf, has been seen in a similar attitude. *Cilix spinula* is well known to resemble a piece of bird-excrement; and I have often seen this moth at rest by day, fully exposed to view, on the upper surfaces of leaves.

It is interesting to observe how, in many cases, natural selection has probably taken advantage of characters originally acquired for some other purpose. Thus the common *Anthocharis cardamines* of this country has been shown by Mr. T. W. Wood to rest at night on the heads of umbelliferous plants, where the green marblings on the underside of the hind wings of the butterfly cause the latter to bear a very exact resemblance to the flower-head. Now, as this style of marbling is common to many butterflies of the genus in various parts of the world, it cannot be assumed that this character has been specially acquired to adapt the insects to umbelliferous flower-heads. It is quite as probable, in the case of *A. cardamines*, that the *habit* of the butterfly has been adapted to its particular mode of coloration, natural selection afterwards perfecting the resemblance. A similar instance is offered by *Lithosia caniola*, the larva of which feeds on *Trifolium repens*, and is stated to occur on stony ground which abounds with a species of small shell, probably a *Helix*? When alarmed the larva rolls itself into a ring and falls off

its food-plant, in which attitude it "has almost exactly the appearance, in form, colour, and size," of one of these shells, "which greatly increases the difficulty of finding them when thus feigning death"*. The habit of rolling up into a ring when alarmed is common with many caterpillars which are found in situations where mimicry of shells cannot possibly be adduced as a reason for the habit. Hence in the case of *L. caniola* I am inclined to believe that natural selection has taken advantage of and improved upon a habit originally acquired for a distinct purpose.

The most remarkable case referable to the present class that has recently been published is that of *Gongylus gongylodes*, Linn., an Indian *Mantis* which simulates a flower†. When exhibiting some of these insects at a meeting of the Asiatic Society of Bengal, Dr. Anderson remarked that when seen from above "they did not exhibit any very striking features beyond the leaf-like expansion of the prothorax and the foliaceous appendages to the limbs, both of which, like the upper surface of the insect, are coloured green; but on turning to the under surface the aspect is entirely different. The leaf-like expansion of the prothorax, instead of being green, is a clear pale lavender-violet, with a faint pink bloom along the edges of the leaf; so that this portion of the insect has the exact appearance of the corolla of a plant—a floral simulation which is perfected by the presence of a dark blackish-brown spot in its centre, over the prothorax, and which mimics the opening to the tube of a corolla. A favourite position of this insect is to hang head downwards among a mass of green foliage; and when it does so it generally remains almost motionless, but, at intervals, evinces a swaying movement as of a flower touched by a gentle breeze; and while in this attitude, with its fore limbs banded violet and black and drawn up in front of the centre of the corolla, the simulation of a papilionaceous flower is complete. The object of the bright colouring of the under surface of the prothoracic expansion is evident, its purpose being to act as a decoy to insects, which, mistaking

* Newman's 'British Moths,' p. 473.

† Proc. As. Soc. Beng., Aug. 1877. For an analogous case see a paper by Mr. Wallace in Macmillan's Mag. for Sept. 1877. The *Mantis* referred to resembles a pink orchid, and is stated to be attractive to butterflies. Prof. J. Wood-Mason informs me that the floral resemblance of the above and other species of *Gongylus* has been known to him for years; but its object had remained unexplained till 1875, when he received from Assam some larvæ of *Hymenopus bicornis*, Serville, in which species the resemblance to a flower is, according to Prof. Wood-Mason, even more perfect than is the case with the *Gongylus*. See also Proc. Ent. Soc., Nov. 7th, 1877, p. xxix.

it for a corolla, fly directly into the expectant, serrated, sabre-like raptorial arms of the simulator."

A case like that of *Gongylus* is of the highest interest—can, in fact, be only *completely* appreciated by the believer in natural selection. The green foliaceous expansion of the limbs and prothorax is common with many species of this group of insects, and serves unquestionably as a protection by causing the insects to resemble leaves. Such, in all probability, was the object of the leaf-like expansions acquired by the ancestor of the present *Gongylus*. Later in the history of the species the acquisition of food became of equal or greater importance than the mere evasion of foes; then we must believe that natural selection took advantage of the underside of the foliaceous expansions and coloured them by minute gradations till they acquired their present floral tints and markings; hand in hand with this modification of colour, habits tending to complete the deception were gradually acquired, till the marvellous coördination which we now behold was perfected.

XIX.—*Descriptions of new Species of Heterocera from Japan.* —Part II. *Noctuites.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

[Continued from p. 85.]

Caradrinidæ.

RADINACRA, n. gen.

Closely allied to *Caradrina*, from which it may at once be distinguished by the great length of the apical joint of the palpi, and the great development of the anal tuft and appendices of the male. Type *R. palpalis*.

81. *Radinacra palpalis*, n. sp.

♂. Colour and general pattern of *Caradrina respersa*, but the transverse lines rather more parallel; the reniform spot irrorated along its outer edge with whitish; the ground-colour of the primaries tinted with reddish; the secondaries paler, whitish, with diffused brownish outer border; the tarsi above blackish, banded with white: wings below browner, discal line on both wings better defined, nearer to the margin; a series of distinct black marginal dots. Expanse 1 inch 5 lines.

Yokohama (*Jonas*).

82. *Amyna stellata*, n. sp.

Smaller than *A. selenampha*, the primaries shorter, shining greyish brown; the two transverse lines well-defined, the inner one irregular and speckled with white scales; a depressed silvery and black spot near the base of the cell; outer line denticulated, edged externally with white scales; a white spot at the end of the cell; a transverse subapical white dash; external border slightly paler, its inner margin broadly trisinuated; costa white-spotted; a marginal series of black and white dots; secondaries paler, fringe whitish, intersected by a brown line; head and collar slightly reddish: underside much like that of *A. selenampha*. Expanse 1 inch 1 line.

Yokohama (*Jonas*).

Size and form of *A. undulifera* from Natal; the primaries above like those of *Perigea punctosa* in marking.

83. *Agrotis illoba*, n. sp.

Nearly allied to *A. agricola*, but altogether of a duller and greyer tint; the markings better-defined; a well-defined waved dentate-sinuate discal dusky line; submarginal area bounded internally by a very irregular zigzag pale line; secondaries whiter than in *A. agricola*; thorax pearly greyish; anal tuft testaceous: secondaries below with dusky costal and apical areas; a well-defined blackish discocellular spot. Expanse 1 inch 10 lines.

Hakodaté (*Whitely*).

84. *Agrotis ingrata*, n. sp.

Allied to *A. segetum*, but readily distinguishable by the pale greyish or whitish outer border of primaries, the sordid-brownish secondaries, and the pale greyish thorax. Expanse 1 inch 8–10 lines.

Yokohama (*Jonas*).

85. *Agrotis odiosa*, n. sp.

Colour and general character of the reddish form of *A. saucia*, but smaller, the orbicular and reniform spots ill-defined and red; the secondaries shining whity brown, with no distinct outer border and without the blackish dots on the veins below. Expanse 1 inch 8 lines.

Yokohama (*Jonas*).

86. *Agrotis ustulata*, n. sp.

Somewhat allied to *A. annexa*: primaries above pale

brown, clouded and transversely striated with blackish; a patch at the base of the cell (bordered below by a black line), the reniform and orbicular spots, apex and inner margin of the external border pale silvery brown; secondaries sordid white, the apex and veins brown; a dark brown marginal line; body greyish brown, anal segments of abdomen laterally tufted with fawn-colour; wings below without markings; body below reddish; tarsi above alternately banded with black and white, below reddish banded with black. Expanse 1 inch 8 lines.

Yokohama (*Jonas*).

TRIPHÆNOPSIS, n. gen.

Allied to *Triphæna*, but readily distinguished by the form of the primaries, which is that of *Catocala*; palpi with longer terminal joint; first median branch of primaries emitted nearer to the second but not running so parallel to it, lower radial emitted further from the third median; outer margin undulated; thorax with four central projecting scale-patches. Type *T. lucilla*.

87. *Triphænopsis lucilla*, n. sp.

Size and form of *Catocala diversa*. Primaries above greenish grey, clouded with brown; costa spotted with brown to the end of the cell and with white beyond it; the black lines limiting the central band not distinct above the median vein, undulated, the inner one double; reniform spot white, with a lunate internal brown line; a cuneiform brown-spotted white spot from the outer line to near the external angle; outer border grey, blackish in the centre and at external angle, and bounded internally by a subconfluent irregular series of conical testaceous spots; a black undulated marginal line; fringe with a slender ochraceous basal line, blackish tipped with pale brown; secondaries brown, the fringe, outer margin, and a large central semicircular spot ochreous; a broad marginal border and two or three spots on the fringe black; thorax with the general coloration of the primaries, but with the scale-patches reddish; abdomen greyish with black dorsal tufts, anus reddish at the sides: primaries below blackish, the apical costa spotted with white, fringe spotted with ochraceous; secondaries ochraceous, costal area irrorated with brown; a discocellular lunule and the border as above black; pectus white; legs black, banded with white above, yellowish below; venter testaceous, anus reddish. Expanse 1 inch 9 lines.

Yokohama (*Jonas*).

Triphæna nectens, from India, is a second species of this genus.

88. *Hermonassa cecilia*, n. sp.

Upper surface chocolate-brown; primaries darker than the secondaries, costal margin ferruginous; "orbicular" spot cordiform, the apex pointing outwards, it and the reniform and a fusiform spot below the median vein and nearer to the base blackish, with slender ochreous margin, partly black-bordered; costal and basal areas spotted with black, the interval between each two spots grey; an oblique short ochreous line across the cell near the base; two straight grey lines across the basal area; two parallel arched series of greyish partly black-edged crescents; a submarginal series of black dots; fringe greyish; secondaries slightly sericeous, fringe pale grey, traversed by a dusky stripe; thorax tufted with testaceous, prothorax with a blackish margin and a whitish-tipped fringe, collar testaceous behind; tegulæ blackish, with grey border; abdomen fuliginous: under surface paler, greyer; primaries shining, with fulvous costa, crossed near apex by two divergent blackish lituræ, margin alternately testaceous and black; secondaries with blackish-speckled costal area; legs banded with testaceous. Expanse 1 inch 7–8 lines.

Yokohama (*Jonas*).

Somewhat the aspect of *Graphiphora*, but the primaries narrower, palpi with projecting scales.

89. *Spælotis nitens*, n. sp.

Allied to *S. pyrophila*, but smaller, greyer, the wings more shining, the reniform and orbicular spots smaller and paler, the discocellular spots and discal line below diffused and scarcely distinguishable, the secondaries and the borders of the primaries greyer, and the marginal lituræ blacker. Expanse 1 inch 5 lines.

Yokohama (*Jonas*).

The primaries of this species shine almost like those of a *Plusia*.

90. *Graphiphora exusta*, n. sp.

Allied to *G. rhomboidea*, but redder, the inner edge of the external border of primaries less deeply sinuated, the double discal line of about half the width, quite straight to near the costa, and then abruptly angulated; lines below the cell obsolete; secondaries and abdomen much greyer; discal line below less distinct and nearer to the outer margin. Expanse 1 inch 9 lines.

Yokohama (*Jonas*), Hakodaté (*Whitely*).

91. *Graphiphora canescens*, n. sp.

Allied to *G. brunnea*, but much greyer, the markings less distinct, the bright tawny tints on the primaries and thorax obsolete, the orbicular and reniform spots greyish, not black-edged, the head in front hoary. Expanse 1 inch 7–10 lines.

Yokohama (*Jonas*), Hakodaté (*Whitely*).

Nearly the whole of the darker bands and spots on the primaries of this species are suffused with lilacine grey, so that it is a much duller-looking species than *G. brunnea*; the fringe of secondaries varies from rose-colour to white. In general appearance it resembles *G. baja*.

92. *Graphiphora caliginea*, n. sp.

Allied to *G. sigma*, but with narrower and longer wings, the primaries sepia-brown, with the costal area slightly greyer or redder, but not sharply defined as in *G. sigma*, the discoidal markings less strongly defined, the angular discal stripe less lunated in its divisions and more uniform in width; secondaries sordid shining white instead of brown; the thorax scarcely darker than the abdomen, the head and collar whitish instead of reddish: under surface shining whitish; the primaries with a discal transverse line, twice as far from the margin as in *G. sigma*; secondaries with the discocellular spot barely indicated, and the discal line only visible on the costal area. Expanse 1 inch 11 lines.

Hakodaté (*Whitely*).

93. *Graphiphora? pacifica*, n. sp.

Primaries grey, with the usual irregular outer border limited by a ferruginous whitish-edged stripe, a series of marginal conical ferruginous spots, between which (at the end of the nervures) are white dots; fringe grey, traversed by darker lines, and white-tipped; two diverging central irregular lines enclosing the orbicular and reniform spots, which are whitish, and a blackish spot below the median vein; costa white-spotted; secondaries sordid white, with a broad external sericeous greyish-brown nebula; body grey; head, margins of tegulæ, and abdomen whitish: wings below sordid white, with a well-defined grey discal line and discocellular spot, and reddish apex to each wing; primaries with greyish discoidal area; fringe grey, edged with white and black lines; body below grey, with a feeble pink tint. Expanse 1 inch 10 lines.

Yokohama (*Jonas*).

Allied to *G. elimata* from Georgia; it is possible that it

may be the species intended by Motschulsky's description of *Caradrina variolosa*; but (as in other cases) this can only be decided by an examination of his type. It has the general aspect of *Tæniocampa opima*.

94. *Ochropleura stupenda*, n. sp.

Primaries above shining black, the markings bordered with deep velvet-black, basal two thirds of costal area sandy whitish, with two black basal streaks; an oblique basal litura, a >-like line below the cell, and the front of the discoidal spots testaceous varied with dark red scales; a discal series of small lunate testaceous spots, and a submarginal series of similar brown spots broadly bordered by a velvet-black stripe; a zigzag black marginal line; fringe brown; secondaries sandy whitish, the external half smoky brown, fringe grey-spotted; head and thorax black; collar sandy whitish, with a transverse red posterior line; abdomen grey, whitish at base, with testaceous anal tuft: wings below altogether paler than above, basal area whitish, external area greyish brown, with two brown discal streaks, fringe nearly as above; secondaries with a small black discocellular lunule; body below grey, legs and palpi mottled with testaceous. Expanse 2 inches 2 lines.

Yokohama (*Jonas*).

Orthosiidæ.

95. *Semiophora pallescens*, n. sp.

Allied to *S. gothica*, but with the basal area, the basal half of the costal area, and the orbicular spot whitish, the remainder of the wing paler and more sericeous, the two basal spots united into a black line; the line across the cell blackish (not white-edged); the discal line regularly dentate-sinuate and nearer to the outer border; the margin of the external border not white but pale; secondaries much paler, greyish, sericeous, with more or less distinct darker discal line; body considerably paler: wings below with the discal line nearer to outer margin less distinct, and the discocellular spot on each wing less distinct. Expanse 1 inch 8 lines.

Yokohama (*Jonas*).

96. *Tæniocampa tabida*, n. sp.

Allied to *T. instabilis*; but the disk of primaries is crossed by two tolerably distinct parallel blackish discal sinuated lines; the outer border is not bounded within by ferruginous spots, but terminates on the costa in a trifid black spot, also narrower and brownish; fringe greyish brown, rose-coloured at the base;

secondaries broader, darker, with rose-tinted fringe; head and collar dull white, the latter with a dark reddish marginal line; abdomen whitish at the base: wings below shining sandy whitish, costal areas rose-tinted; two indistinct parallel grey lines across the disk; primaries with the central area broadly grey; pectus rosy, venter sandy whitish, anus testaceous. Expanse 1 inch 10 lines.

Yokohama (*Jonas*).

97. *Tæniocampa carnipennis*, n. sp.

Primaries pinky brown, the orbicular and reniform spots outlined in ferruginous; two irregular lunated discal lines, a black dot on the inner line beyond the end of the cell, two black spots near the base, the lower one large and triangular; a black ⊢⊣-shaped marking on the interno-median interspace; secondaries sordid pearly whitish; thorax coloured like the primaries, abdomen testaceous: under surface pale flesh-colour; costal area irrorated with grey scales; a wavy abbreviated discal transverse line on each wing; primaries with discoidal area brownish; internal area glistening silvery white; secondaries with a black spot at the end of the cell; body below greyish, reddish in front. Expanse 1 inch 10 lines.

Yokohama (*Jonas*).

98. *Tæniocampa ella*, n. sp.

Allied to *T. gracilis*, but rather larger, the markings darker, the discal line of primaries bordered internally by a blackish streak; secondaries broader, whiter; under surface whiter, with well-defined discocellular spots. Expanse 1 inch 9 lines.

Yokohama (*Jonas*).

The dusky-bordered *white* secondaries distinguish this species readily from *T. gracilis*; in the latter they are wholly or largely clouded with greyish.

99. *Orthosia lizetta*, n. sp.

Nearest to *O. lævis*, but larger and paler; no trace of the angular line across the centre of primaries; the inner transverse dentated line absent; the discal series of black dots more oblique and less arched (sometimes absent); limitation of external border not sinuated, straight to near the costa, then abruptly angulated and bounded internally by a squamose black spot, the pale line also bounded on either side by black scales, which form a spot a little below the apex; submarginal spots well marked; secondaries greyish brown, shining,

darker in some examples than in others, and occasionally crossed by a discal series of dusky spots; fringe broader than in *O. lævis*, whitish: under surface paler than in *O. lævis*, with well-marked discocellular spots and discal series blackish.

Expanse 1 inch 6 lines.

Yokohama (*Jonas*).

In some respects this species resembles *Tæniocampa gracilis*.

100. *Dasycampa fornax*, n. sp.

Nearly allied to *D. rubiginea*, but slightly larger, altogether redder; the lines and dots on primaries less sharply defined, greyer; the secondaries paler greyish, with distinctly rosy borders; abdomen whitish at base, otherwise rosy; primaries below redder, without the black discocellular spots or greyish nebula in primaries, the other markings ill-defined; secondaries redder, the discal line more irregular and less defined: body below altogether redder, especially in front. Expanse 1 inch 6 lines.

Yokohama (*Jonas*).

D. fornax may possibly be the insect intended in Motschulsky's vague description of "*Oporina? castaneo-fasciata*;" but it is extremely doubtful.

101. *Hoporina sericea*, n. sp.

Coloration of *H. croceago*, but the primaries more elongated (the form of *Xanthia gilvago*); the grey markings on the primaries less distinct than in *H. croceago*, excepting the three angulated transverse lines; primaries below rather redder, the markings better-defined, secondaries with the markings less defined. Expanse 1 inch 8 lines.

Yokohama (*Jonas*).

But for the entirely different form of the primaries, this might have been considered a variety of *H. croceago*; it, however, differs in its more sericeous wings, the secondaries having quite a pearly appearance by the side of the typical species.

102. *Eupsilia tripunctata*, n. sp.

Allied to *E. satellitia*, but the primaries silvery grey, with slightly dusky central area and outer border; the transverse lines wider apart, the outer one less irregular; the limit of the external border indicated by a brown instead of a pale lunulated line; the three white spots considerably larger, and arranged in a triangular figure, the largest one D-shaped rather than lunate, the lower of the two others much larger than the upper one, and about one fourth the size of the D-shaped spot; secondaries and body also greyer: wings below

much paler, the primaries showing the spots of the upper surface, the transverse lines indistinct, secondaries without markings. Expanse 1 inch 7 lines.

Yokohama (*Jonas*).

A well-marked species, far more pleasing than the European one.

BRACHYXANTHIA, n. gen.

Allied to *Xanthia* and *Xestia*, but differing in the short costal margin of the primaries, the consequently much more convex outer margin of the same wings, the shorter and rounder secondaries, and the longer and more porrect palpi. Type *B. peculiaris*.

103. *Brachyxanthia peculiaris*, n. sp.

Primaries bright stramineous, crossed by brown lines as in *Xestia ochreago*; an additional dark brown oblique line from apex to inner margin, from which a second line is given off from below the reniform spot and runs to the basal third of the costal margin (the two lines together forming a large Y on the right-hand wing); the disk immediately beyond the oblique line purplish brown in the male; secondaries sericeous brown, the costal area, fringe, and outer margin in the female creamy whitish; body coloured like the wings: wings below pale creamy yellow, with a brown discal line which in the male primaries is expanded into a broad band or patch; veins of outer margin, marginal lunules, and a costal dash in primaries brown. Expanse 1 inch 2–3 lines.

Hakodaté (*Whitely*), Yokohama (*Jonas*).

104. *Mesogona contracta*, n. sp.

Allied to *M. acetosellæ*, but with narrower wings; primaries darker, the outer stripe angulated towards the costa; no black discal dots, but a third pale irregular line limiting the greyish external border; secondaries greyer than in *M. acetosellæ*, with black marginal spots; body altogether greyer, the abdomen grey, bordered and tufted with reddish: wings below sordid whitish, tinted with pink; a black discocellular lunate spot, a blackish discal stripe, and marginal black dots on each wing; primaries with the medio-discoidal area greyish; body greyish brown. Expanse 1 inch 11 lines to 2 inches.

Yokohama (*Jonas*).

It is just possible that this may be Motschulsky's "*Agrotis cinnamomea*;" but the description is not good enough for identification.

[To be continued.]

XX.—*Position of the Sponge-spicule in the Spongida; and Postscript on the Identity of* Squamulina scopula *with the Sponges.* By H. J. Carter, F.R.S. &c.

In the 'Annals' for 1870 (vol. vi. pp. 222, 223, pl. xv. figs. 1–7) Mr. Saville Kent has described and figured, under the name of *Rhaphidotheca Marshall-Hallii*, a remarkable little sponge which he found growing on *Lophohelia prolifera*, in 500 fathoms, on the coast off Cezimbra, Portugal, in 1870. A section of the sponge, which was half an inch in diameter, is given in fig. 2 (*l. c.*), where a cell of the *Lophohelia* may be observed to form the centre. On account of the character of the greater part of the spiculation, Mr. Kent rightly calls this little hemispherical sponge an *Esperia*; but the remarkable part is, that it is faced by a layer of pin-like spicules, whose heads, being outwards and in contact with each other, form a kind of tessellated armature on the surface, while their points mingle with the points of the skeleton-spicules of the *Esperia* within. In the footnote at p. 253 (*ib.*) Mr. Kent very naturally, therefore, questions my statement respecting the spicular elements of *Squamulina scopula*, viz. that their "globular heads" being outwards should have satisfied any one that this organism was not a sponge, or words to this effect ('Annals,' 1870, vol. v. p. 312), citing *Rhaphidotheca Marshall-Hallii*, the little sponge to which I have just alluded, as affording an instance to the contrary.

It was not, however, until the latter part of 1877 that I had an opportunity of examining a portion of this interesting little sponge, which, together with two mounted slides of it, was lent to me by my friend Dr. J. Millar, to whom it had been given by Mr. Kent. At first sight I was inclined to agree with Mr. Kent, and said, "Verily (although a pin-like spicule of this form among the Esperiadæ is a great anomaly) here is a sponge with the heads of its spicules outwards, contrary to my assertion that the proper spicules (that is, the spicules made by the sponge itself) never have their large ends outwards." Still this, as will presently be seen, was only a *primâ facie* opinion; for when I came to examine microscopically what Dr. Millar had lent me, much was found to modify these views, since, in addition to the spiculation of the *Esperia* (viz.:—1, a sub-pinlike, staple skeleton-spicule, radiating from the centre in branched bundles; 2, a smaller acerate one, curved and binding together the points of the latter towards the surface; 3, an inequianchorate, single and in rosette-like groups; 4, a bihamate (*fibula*); and 5, the sheaf-shaped bundles of minute acerates, looking like sawdust by reflected light),

there were present the spiro-sinuous flesh-spicules of *Cliona abyssorum*, which I had described and figured from a specimen found in *Lophohelia prolifera*, dredged up at the mouth of the English Channel ('Annals,' 1874, vol. xiv. p. 249, pl. xiv. fig. 33, and pl. xv. fig. 45, *a*, *b*, *c*), to such an extent that it appears in great plurality even in the minute fragments of both slides mounted by Dr. Millar, also in the dust of the pill-box containing the specimen of *Rhaphidotheca*, and in crevices of the pieces of *Lophohelia* which accompanied it.

Thus a very different aspect of this little sponge became manifest, and I could not help inferring that the *Esperia*, as is often the case with sponges not content with their own spicules, or having no means of obtaining silex for forming a sufficient number of them, had not only appropriated the sinuous flesh-spicules of *Cliona abyssorum*, which infests *Lophohelia prolifera*, but the pin-like skeletal ones also; and and that, after all, the presence of the pin-like spicules with their heads outwards did not, in this instance, invalidate the view mentioned, viz. that the proper spicules of a sponge are never found in that sponge with their large ends outwards.

Still, the pin-like spicule in this little sponge is not identical in form with that of *Cliona abyssorum*, as may be seen by comparing Mr. Kent's with my figures of it (*l. c.*); and the only conclusion I can come to, in consequence, is, that Mr. Kent's will be found to characterize a variety of *Cliona abyssorum* in the *Lophohelia prolifera*, bearing the pin-like spicule of this misleading little sponge, or the latter has been modified in form by the *Esperia* itself; which, it is very desirable to determine.

When viewed in a perpendicular section laterally, the real surface of the *Esperia* can be seen to be marked, as usual, by the horizontal layer of acerates binding together the points of the sub-pinlike skeleton-spicules of the *Esperia*, in which none of the sub-pinlike or large ends are observed to be outwards, while the reverse is the case with all the pin-like spicules ,that form its crust, which have been inferred to have come from a *Cliona*—the former being the case with the "proper spicules" of a sponge, and the latter that of spicules derived from another or foreign source. It would be desirable, then, to ascertain if the *Cliona*, which in all probability infests the *Lophohelia* on which this little sponge has grown, has a pin-like spicule like that covering the *Esperia*.

If, however, Mr. Kent has not been happy in the instance of *Rhaphidotheca Marshall-Hallii*, as opposed to my views, he has caused me to considerably modify them, as well as the statement made in my "Notes introductory to the Study of

the Spongida," viz. that "where a spicule which has a point projects beyond the surface of the sponge to which it belongs, that point will be always outermost" ('Annals,' 1875, vol. xvi. p. 16); for this is by no means the case, since where the spicule is intended for anchoring, or for binding down the surface-spicules of the body of the sponge, and by thus intermingling with each other to form a kind of crust, the branched head is outwards and the pointed end of the shaft inwards.

Thus in the anchoring spicules of the hexactinellids *Rossella* and *Euplectella*, in *Geodia*, in *Stelletta* (especially *Wyville-thomsonia Wallichii*), and in *Tethya* (type *T. cranium*), also in some of the calcareous sponges, the former is the case; while the large surface-spicules on the body of *Rossella* and many other hexactinellids, together with the large trifid ("zone-") spicules of *Geodia* and *Stelletta*, especially in *Wyvillethomsonia Wallichii*, all the Lithistids, and some of the calcareous sponges (ex. gr. *Leuconia Johnstonii*, 'Annals,' 1871, vol. viii. pl. i. fig. 6) furnish instances of the latter.

Yet in other cases, where the spicules are not branched, but linear and pointed at both ends, especially in the Renierida, the points bristle on the surface; and that this would be the case if one end were obtuse, is evidenced by the Suberitida, in which the pin-like spicule always holds this position. Even in *Placospongia melobesioides* and *Xenospongia patelliformis*, in which the crusts respectively are composed of a layer of *Geodia*-like siliceous balls and *Stelletta*-like stellates, accompanied by a pin-like skeleton-spicule only, the point of the latter is outwards.

Therefore in the "Notes &c." to which I have above alluded, it should have been stated, in the section immediately following the tabular view of the skeleton-spicules therein given, that while the spicules of the "linear group" have their pointed ends directed outwards, the reverse is the case with the "ramular group." How this omission occurred I cannot conceive, as the last spicules mentioned in this table are the "anchoring" ones of the Hexactinellida. Thus it is rather an error of omission than of commission, of which, I fear, many more will be found in my "Notes."

Postscript.

On the Identity of Squamulina scopula *with the Sponges.*

In a paper entitled "Observations upon Professor Ernst Häckel's Group 'Physemaria,' and on the Affinity of the Sponges," Mr. Saville Kent, in the last number of the

'Annals' (p. 12 *et seq.*), assumes that Häckel has identified my *Squamulina scopula*=*Halyphysema Tumanowiczii*, Bk., with his genus *Gastrophysema*, and then infers (provisionally, p. 15) that, as Prof. Häckel ('Jenaische Zeitschrift,' erstes Heft, Taf. iv.–vi.) represents collared, flagellated, monadic bodies with it, it is a sponge.

Now Häckel has not identified my *Squamulina scopula* with his *Gastrophysema*, as proved by his figures of the latter, wherein the cavity of the body is not prolonged into the polythalamous foot or test; and therefore Mr. Kent's provisional inference falls to the ground.

My *Squamulina scopula*, as may be seen by my figures ('Annals,' 1870, vol. v. pl. iv.), consists of a subpolythalamous discoid test, whose opening on the summit is prolonged into a tubular scopuliform structure, which is simple in one and dichotomously branched in the other species or variety; so that the latter closely resembles in form the calcareous test of *Carpenteria*, whose opening at the summit is also prolonged into a tubular branched state, which is composed partly of calcareous matter supplied by the animal itself, and partly of foreign material consisting chiefly of more or less fragmentary sponge-spicules: when the calcareous tube fails, which is often the case, the tube is *wholly* composed of the latter, like that of *Squamulina scopula*, only that the tubulation of *Carpenteria* terminates in fine branches, while those of *Squamulina scopula* and its variety *ramosa* terminate in round scopuliform extremities.

Again, whether there be collared flagellated monadic bodies in *Squamulina scopula* or not, the polythalamous character, so appropriately given by the illustrious Ehrenberg to what we now call Foraminifera, decides the question with those who are well acquainted with the structure of the latter as well as that of the Spongida. No sponge, that I know of, presents the polythalamous character of *Squamulina scopula*, in its foot (root) or anywhere else.

That Häckel did not know what he was talking about is evident when he attempts to identify the bundle of anchoring spicules of *Wyvillethomsonia Wallichii*, formed by the sponge itself, with the heterogeneous material brought together by the organism which he represents under the name of *Haliphysema echinoides* (*op. cit.* Taf. 11. fig. 127), and which Schmidt would provisionally call "*Stelletta echinoides*" (Archiv f. mikroskop. Anat. Bd. xiv. p. 260).

I do not mean to assert that Häckel's figures of *Gastrophysema* do not represent his Physemaria; but I mean to assert most emphatically that they do not represent my *Squa-*

mulina scopula, any more than his *Hăliphysema echinoides* represents *Wyvillethomsonia Wallichii*. So it is evident from this that, in attempting to generalize,

"A little knowledge is a dangerous thing."

Squamulina scopula in its simple and branched forms is very common on this coast (Budleigh-Salterton, Devon); but if reexamined, as Mereschkowsky suggests a little further on in the same number of the 'Annals' (p. 77), it is impossible to do away with the bearing of the polythalamous character above mentioned, which no sponge that I know of possesses, independent of the other proofs that *Squamulina scopula* is decidedly a species of Foraminifera.

The embryo of the Spongida grows up into branches from a *root*; that of the Foraminifera from a *cell* into cells or chambers, successively increasing in size and, for the most part, arranged spirally. Thus far the two organisms *cannot* be confounded.

XXI.—*Description of a new Scops Owl from Ceylon.* By Capt. W. V. Legge, R.A., M.B.O.U., &c.

At Trincomalie, in July 1875, I obtained a young bird belonging to a small species of Scops Owl unknown to me. I kept it some little time; and it then died. In May of the following year, while staying with Mr. Bligh, of Catton Estate, Haputale, I met with a skin of an adult bird, which he had caught in the chimney of his bungalow at Kotmalie, and which I recognized as belonging to the same species as my young bird. Its small size and dark plumage prevented my identifying it with any Scops Owl described in Mr. Sharpe's Catalogue; and through the kindness of Mr. Bligh I was enabled to send it home to the British Museum. It has now been presented to the national collection by that gentleman.

Messrs. Whyte and Co., of Kandy, have just sent home to Mr. Sharpe, on loan, a second example, killed in one of the coffee-districts near Kandy. On our comparing the series thus obtained with the Scops Owls in the national collection, this species turns out to be new, being distinguished from other Indian members of the genus by its small size and dark colour. Messrs. Whyte and Co. state they have received once before an example of this owl*. I

* I have examined a small rufous owl in the Colombo Museum, which appears to belong to this species.

propose to describe this interesting little addition to the avifauna of Ceylon under the name of *Scops minutus*, it appearing to be the smallest Scops Owl yet discovered.

Scops minutus, sp. nov.

Description.—♂. Length to front of cere (from skin) 6·0 inches; culmen 0·55; wing 4·85; tail 2·1; tarsus 0·8; outer anterior toe 0·7, its claw straight 0·4; height of bill at cere 0·25.

Iris yellow; bill olivaceous brown; cere greenish; feet fleshy brown.

Above the general hue is dark brown, the feathers of the head, back, rump, scapulars, tertials, and wing-coverts crossed at the centre with transverse spots of ochraceous, spotted finely and closely vermiculated on the rest of their surfaces with grey and ochraceous grey, surrounding transverse irregular markings of blackish; the feathers of the hind neck are crossed with bold wavy markings of whitish, and margined with rufescent buff. The outer scapulars are white externally, with blackish terminal spots and oblique central bars of the same, edged with rufous; the primary and outer secondary coverts have their dark markings mingled with rufous patches and set off with white spots near the tips of the outer webs; primaries and secondaries brownish rufous, mottled with blackish brown, and the inner webs banded broadly with the same; the outer webs of the first five primaries crossed with five white blackish-margined bars, the tip paler than the rest of the feather and mottled with dark brown; tail brownish, washed with rufous on some of the feathers near the base, mottled with blackish brown and crossed with five or six bars of buff-white with black edges; ear-tufts concolorous with the head, and rufous at the base of the feathers.

Loreal plumes black, with white bases; facial disk grey, pencilled with blackish; ruff pale rufous, the feathers edged and centred with dark brown; chin whitish; fore neck and under surface, with the flanks, closely stippled with iron-grey on a white ground, the feathers with broadish central stripes of blackish, and crossed on their concealed portions with fine, wavy, transverse, black marks; on the lower parts the stippling is more open, the under tail-coverts being chiefly white, with the markings confined to the tips; legs rufescent, with wavy brown transverse marks; under wing-coverts whitish, shaded with rufescent, and crossed with irregular markings of brown.

The example sent home by Messrs. Whyte and Co., of Kandy, differs in the bolder nature of the transverse white spottings on the upper surface, and in the blackish markings taking the form of distinct shaft-lines; the ruff is more conspicuously edged, and is of a deeper buff than in the Museum specimen; the under surface is not so closely stippled, and does not present the same "pepper-and-salt" appearance, the markings taking the form of vermiculations and the centre stripes being very bold.

This little owl comes nearer to *Scops malayanus* than any other Indian member of the genus, but differs from it in its smaller size and in the darker upper parts and closely stippled under surface.

In its young plumage, it is rufous on the entire upper surface, and the breast is whiter than in the adult.

Habitat. Northern, western, and central provinces of Ceylon, probably the whole island.

Type in British Museum.

Locality. Kôtmalie, Central Province.

BIBLIOGRAPHICAL NOTICE.

White's Natural History of Selborne. Edited by Thomas Bell, F.R.S. Two vols. 8vo. Van Voorst: London, 1877.

A period of well nigh a century has now elapsed since the first publication of Gilbert White's 'Natural History and Antiquities of Selborne,' in 1789; and since then, as we all know, many reprints of this popular work have been from time to time issued, enriched or otherwise, as the case may be, by the notes and commentaries of various editors. With this, all might be supposed to have been done that could be done, and that nothing more was left for us to look forward to than a repetition of the same kind of editorial labour. It is with pleasure, however, that we find such a surmise dissipated entirely by the appearance of the two goodly volumes now before us, which, containing as they do so much new matter regarding our author, may be fairly enough regarded as constituting the one *final* and *exhaustive* record to which all must refer who would know something more of White, not only as a naturalist, but in his more intimate social relations with his family and friends. Hitherto we have had to be content with the meagre though kindly notice prefixed to the edition of White's work published after his death by his friend Dr. Aiken, and consisting of little more than the dates of his birth and educational career at school and college. Now, here was plainly a deficiency to be supplied; and upon whom, we may well ask, could such a task have better devolved than upon the

present Editor, Thomas Bell (himself an able naturalist, and occupier, too, of White's tenement at Selborne for a period of more than thirty years)? Within this studious retirement, and with access to documents and letters such as no one else could command, Bell has been enabled to write a brief memoir of White, which, uneventful as the life of such a student must needs be, will yet be read with interest by all who cherish every scrap of information concerning one who gave to an obscure village in Hampshire, where he lived and died, a name and fame such as but for his labours it had never possessed. To this memoir succeeds the Natural History and Antiquities of Selborne, with notes sparingly because judiciously appended by the Editor from his own and the personal observation of others. And so ends vol. i., complete, so far as it goes, in itself.

The contents of the next volume are entirely new; and to those we beg more especially to direct the attention of our readers. They consist, to begin with, of the correspondence of Gilbert White with his brother John, a clergyman like himself, and bound to him by a peculiar sympathy, as being himself a lover of natural history, and engaged for many years in preparing a work on that of Gibraltar and its neighbourhood—though this, it is to be regretted, was never published. To these letters follow several others that were exchanged between the same brother and *Linnæus*; and last of all an extensive correspondence of Gilbert White with his family, and miscellaneous letters addressed to many of his most intimate friends. When we add that the whole correspondence occupies some 303 pages of vol. ii. we have said enough to indicate the abundance of novel information that will be there met with, and much which is specially interesting as having reference to the favourite pursuits of our author. "On the Sense of Hearing in Fishes," by Gilbert White, is the title of the next article in vol. ii., and is now published for the first time. Out of three of White's sermons in the possession of Mr. Bell, he has thought proper to select one as giving us, he says, "a fair illustration of the general tone of his parochial instruction, and as an example of the ordinary character of the best village sermons of the period."

Lastly, as affording a curious glimpse into the expenses of living at that period, we have the account-book kept by White of moneys *spent* as well as received during the terms of his proctorship &c. at Oxford during the years 1752 to 1754. With the quaint entries here made, and the odd manner in which the figures are disposed, the student of by-gone data will find much that may furnish food for reflection as well as amusement at the same time. We conclude our list of White's writings with his "Garden Kalender" and a "Description of Dufour's Fire-escape," which last, though never perhaps intended for publication, yet shows us that our author was fully alive to any improvement in the useful arts of life. A list of the more noteworthy animals and plants observed in Selborne and its neighbourhood is appended by the Editor. William

Curtis furnishes us with a brief essay on the geology of Selborne; while last, in the form of an Appendix, Lord Selborne gives us an account of his highly successful investigations into the Romano-British antiquities found in the bed of Woolmer Pond and other districts of the parish. A copious index of names and places concludes, we may add, the whole work.

In the above notice we have purposely limited ourselves to telling the reader what these volumes contain. To have entered into any criticism upon the subject-matter of a work, the leading portion of which has so long received the verdict of public approval, would have been here wholly out of place. Sufficient is it to observe that all future competition between publishers for the glory or profit accruing from editions of White's 'Selborne' is now finally set at rest. To Van Voorst and his able Editor belong the exclusive merit of being the first to set before the public the full portrait of Gilbert White and *his* Selborne—that Selborne which he loved so wisely and so well.

MISCELLANEOUS.

Thomas Vernon Wollaston.

Since the issue of our last number we have had to lament the loss of one of the best and most scientific of our entomological contributors. Mr. T. V. Wollaston died suddenly, on the 4th of January, at his residence at Teignmouth; and it is hard to say whether the feeling of regret caused by this untimely event is more inspired by appreciation of the good qualities of the man or of the value of his work. Belonging to a family which numbered Dr. Wollaston among its members, and could boast of more than one name of respectable position in literature, Mr. Wollaston certainly well maintained its credit by his labours in the department of science to which he specially devoted himself; whilst his extreme amiability, gentleness, and straightforwardness of character endeared him to all those who had the pleasure of his personal acquaintance.

Born on the 9th March, 1821, Mr. Wollaston was only in his fifty-seventh year when he died. His love for entomology commenced while he was completing his studies at Jesus College, Cambridge, where the example of our late Botanical Editor, Mr. C. Cardale Babington inoculated him, and two, at least, of his fellow students (the Revs. J. F. Dawson and Hamlet Clark), with a taste for the study of British Coleoptera; and it was upon this subject that he made his first appearance as an entomological writer, with a short note on Coleoptera observed at Launceston, published in 1843, in the first volume of the 'Zoologist.' This was followed in 1845 and 1847 by notes on the entomology of Lundy Island, which appeared in the same periodical; and in the intermediate year (1846) he sent his first contribution to this journal, under the title of "Descriptions of

three newly-discovered British Coleoptera." Other papers, chiefly on the Coleoptera of various districts of the British Isles, were contributed by him to the 'Zoologist' in 1846 and 1847; but in the autumn of the latter year his friends were shocked with the news that he had suffered from a severe attack of blood-spitting, which, although no serious results were immediately to be apprehended from it, would necessitate his passing at least the ensuing winter in a milder climate than that of England. Madeira was the locality selected by him; and to his compulsory visit to that beautiful island we are indebted for some of the finest entomological works of which this country can boast.

From the moment of his landing in Madeira Mr. Wollaston set himself, with the energy and enthusiasm which had always characterized his proceedings, to form a collection of the insects of the island; and although his own predilections led him no doubt to pay special attention to the Coleoptera, he obtained most interesting series of insects belonging to the other orders. So interested was he by the results of these researches, that, although no longer compelled to submit to exile on account of his health, he returned again and again to Madeira, and on these occasions provided himself with a small tent, in which he lived high up among the mountains for weeks together, accompanied only by Portuguese attendants, whose duty it was to bring up the necessary supplies for the little party. By these means Wollaston obtained so large a series of insects, and especially of Coleoptera, that he found himself in a position to give a very exhaustive account of the beetles of the main island of Madeira and of those scattered points of rock, the Salvages and Desertas, which form small groups in its immediate vicinity. After several years of work his results appeared in 1854 under the title of 'Insecta Maderensia,' in a handsome quarto volume, illustrated with coloured plates of beautiful figures, drawn by Mr. Westwood and engraved by Mr. Frederick Smith. The qualities displayed in this great work, the accuracy of research, and the painstaking and thoroughly philosophical manner in which the subject was treated, at once placed Wollaston in the first rank of systematic entomologists; while the curious results of his investigations, revealing as they did, in the little spot of ground on which they had been carried on, a most singular mixture of European and Mediterranean types, with peculiar species, constituting genera and even more extensive groups of which no examples were known elsewhere, gave the work a special interest, and led its accomplished author to speculate on the possibility of the former existence of an Atlantic land, from the inhabitants of which these peculiar types were descended.

By a very natural process such speculations led to the desire to investigate the insect-faunas of the other Atlantic islands; and the entomological portion of the great work of Webb and Berthelot on the Canaries no doubt furnished some indications that interesting discoveries might be looked for there. Accordingly, after making another visit to Madeira in 1855, and preparing a Catalogue of the

Coleoptera of that island, which was published in 1857 by the Trustees of the British Museum, who had purchased his valuable collections, Wollaston (in 1858 and 1859) went to the Canaries in the yacht of his friend Mr. John Gray; and the results of his researches, embodying descriptions of many new forms of Coleoptera and numerous corrections of the statements of previous authors, appeared in 1864, also under the auspices of the Trustees of the British Museum*.

In the mean time, however, other observers had been investigating the Canarian Coleoptera; and in the very next year after the publication of his Museum Catalogue, Wollaston found himself under the necessity of bringing out a fresh book, entitled 'Coleoptera Atlantidum,' in which he not only gave a complete list of the species, with descriptions of many new ones, but discussed at considerable length the theoretical conclusions to which he was led by his examination of them. For the further confirmation of these conclusions he again embarked on board Mr. Gray's yacht in 1866, for a cruise among the Cape-Verde Islands; and the fruits of this journey appeared in the following year under the title of 'Coleoptera Hesperidum.' Later still he undertook the investigation of the beetles of St. Helena; and his descriptive notice of these, 'Coleoptera Sanctæ-Helenæ,' which appeared only last year, showed a considerable advance even upon the results recently published by Mr. Melliss.

From his investigations of the Coleoptera of all these little islands scattered so widely over the Atlantic, Wollaston was strongly confirmed in his belief that they are relics of a great tract of land or group of large islands, now submerged, except the summits of its highest mountains, which afford a refuge for the descendants of a few of its peculiar inhabitants. These points, and many others of interest with regard to geographical distribution, are discussed with great acumen in the introductions to the works above cited.

Throughout his career Wollaston maintained the independence of species, and indeed was, for a long time, an ardent opponent of the doctrine of evolution. His opinions on this subject took a somewhat modified form in his later writings, in which he accepted the notion that some forms which could hardly be regarded otherwise than as species had a recognizable derivative origin. As early as 1856 he published a small work on the Variation of Species, which contains many valuable remarks on this subject and also discusses the nature of genera.

Notwithstanding his special devotion to the study of the Coleoptera, Wollaston found time to attend to some other things during his visits to the Atlantic islands. In his first sojourn in Madeira the Rev. R. T. Lowe, then chaplain at Funchal, called his attention

* It is to be hoped that the beautiful collections, both of shells and insects, upon which Mr. Wollaston was at work until the very close of his life may be acquired by the national Museum, and placed side by side with those earlier collections which are already in its cabinets.

to the existence of many peculiar forms of land-shells on the island; and Wollaston collected these with such zeal, that in a very short time he had obtained examples of a great many more species than had fallen to the lot of Mr. Lowe during several years' residence in Madeira. A descriptive account of these shells, and of others obtained by him in other Atlantic islands, was his last completed work, and will, we hope, appear shortly.

This notice has already extended to such a length that it will be impossible to refer particularly to any of Wollaston's scattered papers. From 1846 until last year he was a frequent contributor to our pages, in which many of his best papers appear. Others, of equal value, will be found in the Transactions of the Entomological Society, in the 'Journal of Entomology,' and in the 'Entomologist's Monthly Magazine.' Altogether he published about 50 separate papers, nearly all relating to Coleoptera.

When we consider that for 30 years of his life Wollaston was always in a most delicate state of health, the amount and the quality of the work done by him is at first sight surprising. But it may be that the very weakness of constitution which all his friends deplored was really to some extent the cause of his success, by preventing his going much into society, where his kindness and geniality must have made him a favourite, and compelling him to live for the most part in a retirement which afforded him so many opportunities of devoting himself to the patient and minute research by which, coupled with the power which he eminently possessed of taking broad and philosophical views of his results, his reputation was mainly built up.

On the Orthonectida, a new Class of Animals Parasitic on Echinodermata and Turbellaria. By M. A. Giard.

The little Ophiuran, *Ophiocoma neglecta*, sometimes contains a singular parasite which may serve as the type of a whole group of animals of very curious organization and hitherto almost unknown. The following are the circumstances under which this parasite is met with. *Ophiocoma neglecta* is an Ophiuran with condensed embryogeny, or viviparous. The incubatory cavity, situated in the aboral part of the disk, communicates freely with the exterior; for the most advanced embryos contained in this cavity frequently present upon their arms a pretty *Vorticella*, which occurs almost always upon the arms of the parent animal. On tearing open the disk in order to extract the embryos from it, we find it, in certain individuals, filled with a multitude of animals like large ciliated Infusoria, which traverse the field of the microscope in a straight line and with the rapidity of an arrow. These animals occur of two forms, which I shall name provisionally the *elongated* and the *ovoid form*. In both they are simple *planulæ*, that is to say, organisms composed only of two layers of cells—an exoderm or outer layer of ciliated cells, and an endoderm consisting of larger cells bounding a linear central cavity with no buccal aperture or anus. Notwith-

standing this low organization, the body is metamerized, and the metameres even present remarkable differentiations. The first ring terminates anteriorly in a blunt cone and bears a tuft of rigid setæ. It is followed by a cylindrical ring of the same length, the whole surface of which is roughened with papillæ, apparently disposed in ten longitudinal rows; this is the only part of the body which does not present vibratile cilia. The third ring is larger than the first two taken together: it widens gently towards its posterior extremity. The fourth metamere is of the same dimensions as the papilliferous ring; it is followed by a terminal ring, furnished with longer cilia at its posterior extremity, conical and subdivided into two metameres less distinct than the preceding ones. Such is the elongated form. The last rings form a sort of club with which the animal beats the water, independently of the movements of the cilia, and by sudden blows which one might think due to the action of muscular elements. The ovoid form differs from the elongated form only in its less length and greater breadth; but I have ascertained that it is not the result of a contraction of the animal. Perhaps it is a sexual form, perhaps also a young state of the parasite. I give this strange animal the name of *Rhopalura ophiocomæ*.

A parasite of the same group is also met with at Wimereux, in a Nemertean, *Lineus gesserensis*, O. F. Muller, which is very common, as well as its variety *L. sanguineus*, under the stones of the muddy places in the neighbourhood of the Tour de Croi. This animal differs, however, sufficiently from *Rhopalura* to constitute a distinct genus; the papilliferous ring is replaced by two very narrow ciliated rings; the median portion of the body generally has six nearly equal metameres; the terminal club is formed of three rings: the anterior part, moreover, bears a tuft of rigid cilia. There are also an elongated and an ovoid form. M'Intosh has said a few words on this parasite in his fine monograph of the British Nemerteans*; I therefore propose to give it the name of *Intoshia linei*.

Lastly a species evidently belonging to the same genus has been figured without description by Keferstein †, who met with it at St. Malo as a parasite in the digestive tube of a Planarian (*Leptoplana tremellaris*) which is also very common at Wimereux. I give this species, which is very nearly allied to the preceding, the name of *Intoshia leptoplanæ*.

In the absence of sufficient embryogenical evidence, it is impossible for me at present to assign these animals to the definitive place which they must occupy in the classification. By the name ORTHONECTIDA I have desired to recall their progression, which is so characteristic that it would of itself suffice for their recognition among the parasites with which they might be confounded. Provisionally I think that the Orthonectida should be ranged above the Dicyemida and near the Gastrotricha; the latter and the degraded Rotifers also

* M'Intosh, 'A Monograph of the British Annelids: the Nemerteans,' 1874, p. 120, pl. xviii. figs. 17-19.

† Keferstein, 'Beiträge zur Anatomie und Entwickelungsgeschichte einiger Seeplanarien von St.-Malo,' Taf. ii. fig. 8.

live in general upon animals which inhabit muddy bottoms, such as *Ophiocoma neglecta*, the *Linei*, and *Leptoplana tremellaris*. Such are *Balatro*, parasitic on the Limnicolous annelids, and *Saccobdella*, a parasite of *Nebalia* *. However, the Orthonectida possess neither the rotatory apparatus nor the mastax of the Rotifera, nor even the bifurcated tail or the pharynx of the Gastrotricha. The most interesting question to be solved in the history of our parasites is whether these animals have remained normally at the *planula*-stage, or have retrograded to this primitive state, just as the Dicyemida have returned to the *morula*-stage, in consequence of parasitism. The fact of retrogression does not seem to me to be doubtful in the case of the Dicyemida, which I regard as degraded Turbellaria (the *Dicyema* of the cuttlefish still possesses the bacilli so characteristic of the skin of the Planarians). The proofs of the degradation of the Orthonectida are far from being so evident; and these animals perhaps represent the most interesting step in the complicated phylum of the Vermes†.—*Comptes Rendus*, October 29, 1877, p. 812.

A new Species of Chimæra *found in American Waters.* By Theodore Gill.

One of the most unexpected discoveries recently made in American ichthyology is that of a species of the genus *Chimæra*, of which a specimen has lately been sent to the Smithsonian Institution. It was caught south-east of the La Have bank, in lat. 42° 40′ N., long. 63° 23′ W., at a depth of 350 fathoms, with a bait of halibut. An attentive comparison of the specimen with individuals of the European *Chimæra monstrosa* renders it evident that it does not belong to that species, but is an entirely distinct specific form. It may be named *Chimæra plumbea*, and diagnosed as follows:—

Chimæra plumbea.

A *Chimæra* with the snout acutely produced; the anteorbital flexure of the suborbital line extending little above the level of the inferior margin of the orbit; the dorsals close together; the dorsal spine with its anterior surface rounded; the ventrals triangular and pointed; the pectorals extending to the outer axil of the ventrals; and the colour uniformly plumbeous.

By these characters the species is readily separable from the *Chimæra monstrosa* and other species of the genus.—*Bulletin of the Philosophical Society of Washington.*

Note on the Habits of Young Limulus. By Alexander Agassiz.

Mr. C. D. Walcott has called attention to the fact that when collecting fossils he finds large numbers of Trilobites on their back ‡;

* Claus still places *Saccobdella* among the Hirudinea; and this error has unfortunately not been corrected in the French translation of his treatise on Zoology.

† The preceding investigations were made at the Laboratory at Wimereux, in September and October of the present year (1877).

‡ Ann. Lyc. Nat. Hist. xi. p. 155, 1875; Twenty-eighth Report N.Y. State Museum, Dec. 1876.

from this he argues that they died in their natural position, and that when living they probably swam on their backs. He mentions, in support of his view, the well-known fact that very young *Limuli* and other Crustacea frequently swim in that position. I have for several summers kept young horseshoe crabs in my jars, and have noticed that, besides thus often swimming on their backs, they will remain in a similar position for hours, perfectly quiet, on the bottom of the jars where they are kept. When they cast their skin it invariably keeps the same attitude on the bottom of the jar. It is not an uncommon thing to find on beaches, where *Limulus* is common, hundreds of skins thrown up and left dry by the tide, the greater part of which are turned on their backs. An additional point to be brought forward to show that the Trilobites probably pass the greater part of their life on their back and die in that attitude, is that the young *Limuli* generally feed while turned on their back; moving at an angle with the bottom, the hind extremity raised, they throw out their feet beyond the anterior edge of the carapace, browsing, as it were, upon what they find in their road, and washing away what they do not need by means of a powerful current produced by their abdominal appendages.—*Silliman's Amer. Journ.*, Jan. 1878.

New Species of Ceratodus *from the Jurassic.* By O. C. Marsh.

Among the interesting vertebrate remains recently found in the Jurassic of Colorado is a tooth of a *Ceratodus* in good preservation. The specimen is a left lower dental plate, having the inner side convex, and the outer divided into five prominent projections, which are separated by four notches. The front projection is longest and most pointed. The plate is attached to a portion of the dentary bone.

The length of this dental plate is 20 millims., and the transverse diameter 11 millims. The species is the first Mesozoic *Ceratodus* found in this country, and hence of much interest. It may be named *Ceratodus Güntheri*, in honour of Dr. A. Günther of the British Museum. The geological horizon of this species is in the *Atlantosaurus* beds of the Upper Jurassic.—*Silliman's Amer. Journ.*, Jan. 1878.

Sexual Dimorphism in Butterflies.

Mr. S. H. Scudder, in an article on sexual dimorphism in butterflies (to which special kind of dimorphism he applies the term *antigeny*), states that it is not the male but the female that departs from the normal type of colouring of the group to which the species belongs, while it is the male that shows divergences from the type in structural characters. These structural divergences in butterflies appear in the wings and the legs, and sometimes in the antennæ. Mr. Scudder knows of no example in which the male alone diverges from the general plan of coloration belonging to the group.—*Proc. Amer. Acad.* 1877.

THE ANNALS

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XXII.—*On the Geographical Distribution of the Common Oyster.* By G. WINTHER*.

APART from the oysters of the Mediterranean, which are here left out of consideration, the oyster is found along the coasts of the Bay of Biscay, from Vigo in Spain to Finisterre in France, and thence along the coasts of the Channel, the Irish, Scotch, and English seaboards as far as the Shetland Islands. The species reappears at Heligoland, on the western coast of Slesvig, in the Limfjord, the Aalbæk Bay in the Kattegat (near Frederikshavn or Fladstrand), and along the eastern shore of Jutland, as far as the fjord of Horsens, whilst on the coast of the Scandinavian peninsula oysters are found from a point south of Gothenborg along the Swedish and Norwegian coasts towards the bay of Christiania, and again on the south and west coast of Norway as far as the island of Tränen, near the polar circle. The Færoes and Iceland possess no oysters; and it is doubtful whether the American oyster is of the same species as that of Europe. In spite of its wide range northwards, the oyster must be regarded as a southern species, being most fully developed in the Channel and south of the Channel.

If now we look for peculiarities common to the whole of this portion of the west coast of Europe which is inhabited by the oyster, we meet with one phenomenon which exercises

* Abstract of a paper on the culture of oysters in Denmark, in 'Nordisk Tidsskrift for Fiskeri' (Copenhagen, 1876).

the greatest influence on Western Europe in point of climate and fauna, viz. the *Gulf-stream*, branches of which cross the northern portion of the Atlantic and touch precisely on the coasts in question.

According to the most modern researches, a branch of the Gulf-stream strikes the north-west corner of Spain and separates into two minor currents, of which one runs southwards past Vigo, along the coast of Spain and Portugal, whilst the other follows the shore of the Bay of Biscay to the western extremity of Brittany. The direction of this current along the French coast is therefore first northerly and then, along the S.W. coast of Brittany, north-westerly. After leaving the western extremity of Brittany the current maintains this north-westerly direction, following the edge of that submarine plateau on which both France and England are situated; and near the coast of Ireland this branch reunites with the main portion of the Gulf-stream, which, having crossed the Atlantic flows along the western shores of Ireland, Scotland, and the Shetland Islands. From this point the stream, following still the edge of the plateau, strikes across to the coast of Norway, which it touches first between Bergen and Trondhjem, spreading thence along the coast as far as the North Cape. From that branch of the Gulf-stream which, as we have described, crosses the mouth of the Channel, a minor branch diverges into the Channel, after passing which it spreads into the southern division of the North Sea, where its effects are well marked. After passing along the coast of Holland it touches Heligoland and the islands west of Slesvig, and follows the west coast of Jutland as far as the Skaw, where an ultimate bifurcation takes place, one branch passing to the Swedish coast, whilst the effects of the other, which runs southwards along the east coast of the Cimbrian peninsula, can be traced as far as the Bay of Kiel.

All along these coast-lines, which are touched by the Gulf-stream, and where consequently the saltness and temperature of the water are proportionally high and independent of local circumstances, oysters are found. They constitute its specific area, according to the terminology of Mr. Forbes. How entirely the oyster depends on the Gulf-stream is beautifully illustrated in the Kattegat, where it does not reach so far south on the Swedish coast as on the Danish coast, obviously because the rather fresh current from the Baltic flows chiefly along the coast of Sweden, whilst the salt current from the North Sea follows the shore of Jutland. Oysters occur also near the island of Anhalt, in a place where a local northern current has often been observed; but the locality would not

appear to be otherwise favourable, as no fishery has been established there.

It may therefore be said, with justice, that the oyster inhabits the shores of Europe so far as these are touched more or less directly by the Gulf-stream, reaching northwards as far as the polar circle—the Channel and the south coast of England forming the centre of its distribution.

That the oyster does not occur on the shores of Iceland or the Færoes, is interesting in so far as it shows that its diffusion is due to the facility with which the spat is carried on by the current. No current coming from the English or other European coasts, and by which spat might be brought, impinges on the shores of Iceland or the Færoe Islands; the waters of the Gulf-stream by which they are washed come direct from the channel of the Bahamas.

If it be granted that the oyster has been carried to its present stations by the various branches of the Gulf-stream, it may be concluded that its specific centre is the place where that stream first reaches the continent of Europe, viz. the west coast of Spain, from which it has afterwards spread southward into the Mediterranean, and northwards as far as the polar circle. This, again, would be a point to be considered in settling the question as to the physical conditions accompanying the deposition of the Crag formation in England and the strata north of Gothenborg near Uddewalla, in which oysters occur in a fossil state.

But though oysters occur along the whole of the line indicated, they are by no means equally plentiful or well-developed at all points. Oyster-banks occur in many places, even as far north as Bergen in Norway; but those along the shores of England and France seem by nature to be the richest. On these banks, which are situated at varying distances from the shore, and where the oysters live in the pure water entering from the Atlantic, having a saltness of 3·5 or 3·6, they grow to a good size and produce many young; but they do not reach that fulness and delicacy which is obtained by moving them from the breeding-places to other localities exhibiting certain peculiar conditions. The places where oyster-culture succeeds have this in common, that they are protected by islands or shoals against the immediate influence of the open sea, and that the sea-water is diluted by the fresh water of rivers charged with a quantity of organic matter, which affords nourishment to the oysters. Transferred to such places the oyster is considerably improved in size and taste; the liver is more particularly increased; and the shells become more regular, because the animals are so openly scattered as

not to interfere with one another. On account of the water being less salt (2·9–3·1) the shells are thinner than on the natural banks, in accordance with what has been observed also in the case of other testaceous mollusks. Through these changes the oyster is improved as an article of food and commerce; but the improvement is not attained without another effect, which accompanies artificial fattening of animals as commonly as the abnormal increase of the liver does, and which is of the greatest importance for the whole question of oyster-culture. All the physiological energy of the animal being concentrated on the development of the individual, another side of its life, its capability for continuing the species, is impaired. Several authors have noticed the small quantity and limited vital power of the spat produced by oysters in artificial parks; but the fact has not as yet received the attention it deserves; it has not been observed that it is a regular effect of less salt water and that consequently parks for fattening oysters cannot be self-supporting in the long run.

A diminution of the saltness of the sea amounting to 0·5, in connexion with certain other physical circumstances, particularly an admixture of fresh water, is consequently enough to exercise a notable influence on the development of the oyster generally, and especially on its power of propagation. This check will increase in effectiveness with the admixture of fresh water; and there is a point where the individual oyster is still perfectly able to live and thrive, but unable to propagate the species. Experience shows that oysters are able to live long in water of much less saltness, and even attain a size and delicacy which could not be reached if any part of its vital power were to be spent on propagation of the species. The minimum of saltness compatible with the existence of oysters has not yet been determined; and the circumstance that the animal is very susceptible to cold, if the saltness of the water decreases, renders experiment on this point very difficult. Von Baer puts this minimum at 1·7; but propagation is then out of the question. In several instances different banks in the same locality have been found to exhibit great differences with regard to fertility; and it has been suggested that the reason might be that the products of the generative organs do not come to maturity in all individuals at the same time. But it is probable that their more or less favourable situation in regard to the access of salt water is of not less importance in the matter—particularly as the degree of saltness of the water would probably show its effects not only in increasing or diminishing the general fertility, but also in accelerating or delaying the maturity of the secretions in question.

From the preceding it appears that the physiological conditions of the oyster, and especially its power of propagation, may be changed or checked through modifications of circumstances, such as admixture of fresh water or greater tranquility of the water, in respect of which there may be notable differences between localities situated at short distances from one another; and it is evident that this circumstance must act as a bar to its diffusion over a wider area, particularly because it is combined with this other peculiarity, that the brood of oysters is capable of surviving, freely drifting about, only for a short time after having left the mother; it must sink to the bottom after a certain time, and remain where it sinks, whether the place is favourable for its development or not. A very gradual modification of the kind indicated occurs in the water of the Kattegat, where the salt water of the North Sea meets and is gradually mixed with the fresher water of the Baltic; and accordingly the oyster becomes more and more rare as we proceed southwards. At the entrance to the Sound and the Belts the species ceases to occur, though the water is not fresher than it might survive and even thrive in; but it could not propagate there; and the nearest place where the physical conditions of the water permit it to do so, viz. the Bay of Aalbæk, just south of the Skaw, is so far away that the spat, drifting with the current, must, as a rule, sink before it arrives so far. Between these banks and the southern limits of the oysters in the Kattegat they occur only seated on large stones, singly or rarely three or four together. These scattered individuals are often large and fat, but they are barren.

With regard to parks for fattening oysters the main result of these considerations is, that they may be established in places where the water is much less salt than on the natural banks, if otherwise the conditions are favourable, as to temperature, quality of the bottom, quantity of food, &c.; but they cannot be made self-supporting. If artificial banks are to be self-supporting the water must not be much less salt than on the natural banks from which they are stocked.

XXIII.—*Note on* Selaginopsis (=Polyserias Hincksii, *Mereschkowsky*), *and on the Circumpolar Distribution of certain Hydrozoa.* By the Rev. A. M. Norman, M.A.

The *Polyserias Hincksii* of Mereschkowsky, recently figured in the 'Annals' (ser. 4, vol. xx. pl. vi. figs. 15, 16), from the White Sea, is, I think, unquestionably identical with

Diphasia mirabilis, Verrill, described originally from Le Have and St. George's Banks, on the New-England coast, and subsequently figured by Clark from the Alaskan Sea.

The genus *Polyserias* will also be synonymous with *Selaginopsis*, lately described by Prof. Allman, with a type (*S. fusca*) found in Japan *. The White-Sea species will therefore be *Selaginopsis mirabilis* (Verrill).

Until quite recently the Hydrozoa have been almost entirely neglected in all seas except our own, though we must not forget the important investigations of L. and A. Agassiz. We thus know very little of the geographical distribution of the species. *Selaginopsis mirabilis* is the first arctic Hydrozoon which has been described from the east and west coasts of North America and subsequently found in the north of Europe. It is no wonder, therefore, that Mr. Mereschkowsky, having examined European literature without finding his species, should have supposed that it was new. The researches of Verrill on the New-England coast are materially extending our knowledge of the distribution of many classes, including the Hydrozoa, on the western side of the Atlantic; and Mr. S. F. Clark's admirable report on the Hydrozoa of Alaska has special interest. In it he figures, and describes when necessary, forty-two species as inhabiting the district. No less than sixteen of these are Arctic species which reach the British coast, and the circumpolar distribution of which has now been established. They are:—

Obelia longissima (*Pallas*).	Calycella syringa (*Linn.*).
Clytia Johnstoni (*Alder*).	Coppinia arcta (*Dalyell*).
Campanularia integra, *Macgil.*	Halecium muricatum, *Johnst.*
Gonothyræa hyalina, *Hincks.*	Sertularia filicula, *E. & S.*
Lafoëa pocillum ?, *Hincks.*	Sertularella tricuspidata, *Alder.*
—— gracillima (*Alder*).	—— rugosa (*Linn.*).
dumosa (*Fleming*).	—— polyzonias (*Linn.*).
fruticosa, *Sars.*	Tubularia indivisa, *Linn.*

Add to these *Selaginopsis mirabilis* and we have two fifths of the Alaskan species with a known circumpolar distribution.

Selaginopsis and *Pericladium* are apparently Arctic genera which have reached Japan by way of Kamtschatka and the Kurile Islands—the course of distribution which has caused, I believe, the striking resemblance in many features between the British and Japanese marine faunas; and I venture to predict that many genera which are common to Japan and Euro-

* Linn. Soc. Journ. vol. xii. (1876) p. 272. Another of Clark's Alaskan species, *Thuiaria cylindrica*, belongs to Allman's genus *Pericladium*, described in the paper just quoted, p. 273.

pean seas will be found to have their relationship based on a common arctic origin.

Mereschkowsky states that he has "found several other species of this genus (*Polyserias*) in the collection of Hydroids in the St.-Petersburg Museum of the Academy of Sciences, brought from the sea of Ochotsk and Kamtschatka." It is not unlikely that the typical species of *Selaginopsis* may be found in the localities referred to; and the genus *Pericladium* is also almost sure to live in seas which are midway between Alaska and Japan.

Sertularia fusca, Johnston, of the British seas, is a connecting link between the ordinary species of *Sertularia* and the typical *Selaginopsis fusca*.

Selaginopsis fusca of Japan is a connecting link between *Sertularia fusca*, Johnston, and *Polyserias Hincksii*, Mereschkowsky.

Each of these *might* be made the type of a separate genus; but Allman's genus as characterized will include all; and it seems best so to retain it.

Genus Selaginopsis, Allman.

"*Trophosome.*—Hydrophyton consisting of a single axile tube, to which the hydrothecæ are adnate, and on which they are disposed in several longitudinal rows."

"*Gonosome.*—Not known." [In the British *S. fusca*, Johnston, the gonotheca is pyriform, and borne as in *Sertularia*].

1. *Selaginopsis fusca* (Johnston).

Sertularia fusca, Johnston et auctorum.

In this species the hydrothecæ, instead of being placed on the face of the branch as in *Sertularia*, are inserted on the side, the thickness of the branch being much greater in proportion to its breadth than in that genus. On each of the sides the hydrothecæ are biserial, so far that they are decidedly alternate, bending to the right and left, in such a way that the mouths of one half only of the cells on each flank are seen when one face of the branch is looked at, and the other half when the opposite face is examined. It is, in fact, a double arrangement of a *Sertularella*, each *lateral* view exhibiting a series of hydrothecæ corresponding to that of the *front* aspect in *Sertularella*.

Hab. Distribution as known very limited; confined to east coast of the north of England and Scotland.

2. *Selaginopsis Allmani.*

1876. *Selaginopsis fusca*, Allman, Linn. Soc. Journ. vol. xii. p. 272, pl. xii. fig. 1, and pl. xix. figs. 1, 2.

This Japanese species has similarly the hydrothecæ arranged in double file on each *side* (as opposed to the face) of the branchlets; but they are here distinctly in two lines at their bases as well as at their apices, the arrangement of cells being, as it were, that of a double *Sertularia* (e. g. *S. abietina*); instead of a double *Sertularella* as in the last case.

3. *Selaginopsis mirabilis* (Verrill).

1873. *Diphasia mirabilis*, Verrill, Amer. Journ. Science, ser. 3, vol. v. p. 9 (note).
1876. *Diphasia mirabilis*, S. F. Clark, in Scientific Results of Exploration of Alaska, vol. i. p. 15, pl. vii. fig. 36.
1877. *Polyserias Hincksii*, Mereschkowsky, Ann. Nat. Hist. ser. 4, vol. xx. p. 228, pl. vi. figs. 15, 16.

Hab. New-England coast (*Verrill*), Alaska (*Clark*), White Sea (*Mereschkowsky*).

Here we find the process of multiplication of cells carried still further, and what was in the former instances comparable to a double Sertularian, is here equivalent to a triplicate Sertularian, an extra pair of hydrothecæ being introduced.

The general aspect of the hydrophyton, as represented in fig. 15 ('Annals'), reminds us strikingly of that of *S. fusca*, Johnston, in mode of ramification, in general aspect of the branchlets, and in their great slenderness at the point of attachment to the main stem.

XXIV.—*Descriptions of new Species of Heterocera from Japan.*—Part II. *Noctuites.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

[Continued from p. 169.]

Cosmiidæ.

105. *Cosmia distincta*, n. sp.

Primaries grey, crossed by two blackish-edged white lines, much as in *C. affinis*; an abbreviated basal white litura; central area more or less clouded with ferruginous, with a central brown angulated belt; external area dusky, limited internally by an irregular whitish streak; a semicircular whitish-bordered costal brownish spot, much like that of *C.*

pyralina; secondaries as in *C. affinis*: under surface intermediate in colouring and marking between *C. pyralina* and *C. affinis*. Expanse, ♂ 1 inch 5 lines, ♀ 1 inch 7 lines.

Yokohama (*Jonas*).

C. affinis occurs also at Yokohama, but is slightly larger than European examples.

Hadenidæ.

106. *Raphia fasciata*, n. sp.

Silvery greyish, rather darker than *R. viminalis*, with the ground-colour of the central band and base of costal area in primaries dark brown, spotted with black, the interno-basal area silvery white. Expanse 1 inch 3–4 lines.

Yokohama (*Jonas*).

Very close to *R. viminalis*, but having a very distinct aspect, owing to the blackish band and the large pale silvery interno-basal patch.

107. *Phlogophora beatrix*, n. sp.

Closely allied to *P. iris*, larger; more stramineous; the wings broader in proportion; primaries with the darker markings more olivaceous; the outer border not reddish; the margin distinctly dentate-sinuate; the fringe tawny; a marginal series of black lunules, the discal streaks nearest to the margin slender and dentate-sinuate; the two inner discal lines more slender, wider apart, and less angular; the central patch with convex (not angular) front margin; the discoidal spots less oblique, the secondaries clearer, yellower, the lines on the disk abbreviated and fainter: under surface clear straw-yellow, with an abbreviated discal line halfway between the cell and apex; fringe of primaries tipped with blackish. Expanse 2 inches.

Hakodaté (*Whitely*).

Intermediate in form and marking between *P. iris* and *P. periculosa*.

APLECTOIDES, n. gen.

Allied to *Aplecta* of Guénée (*Mamestra*, Ochs., Grote), but differing in its shorter and broader primaries, with straighter costal margin; secondaries with the discocellulars more strongly angulated, the radial nervure emitted further from the median branches: body shorter; palpi more erect, the terminal joint on a level with the top of the head. Type *A. condita* of Guénée.

108. *Aplectoides nitida*, n. sp.

Allied to *A. condita*, much larger; primaries shining silver-grey, with black lines and white spots; lines towards the base nearly straight below the median vein; orbicular spot small, clouded, distinctly black-bordered; reniform spot clouded, indistinct in front, because immediately followed by a patch of white, through which the sinuated portion of the discal black line passes; the latter followed by a less-distinct parallel line from the costa to the third median branch; externo-discal white limitation of the outer border much less defined than in *A. condita*, partly black-bordered; a longitudinal black dash, just above the third median branch, from the reniform spot to the outer border; fringe and apical costa brown; secondaries smoky brown, fringe greyish; thorax white, collar with a broad blackish band in front; metathorax and tegulæ crossed by two black belts; frons black; palpi black, whitish inside; abdomen fuliginous: under surface fuliginous, paler towards the base of the wings; a dusky transverse discal stripe, angulated in primaries; marginal line black; apical costa and fringe of primaries tinted with tawny, the rest of the fringe alternately sordid white and blackish; legs black, femora and tibiæ clothed with greyish hairs, tibiæ and tarsi banded with white. Expanse 2 inches 1 line.

Yokohama (*Jonas*).

In most examples the primaries above have the internomedian area whitish to just beyond the sinuous discal line.

109. *Eurois virens*, n. sp.

♂. Primaries bright sap-green, with the usual spots; internal border, veins, and fringe brown; costal border irrorated and spotted with black, the spots arranged in pairs, with paler green between them; discoidal spots margined with whitish and black, the reniform spot varied with red, deeply angularly excised in front, the inner ("orbicular") spot quadrate; two black lunules below the last-mentioned spot and crossing the interno-median area; an angular discal series of black-edged, pale green lunules; a submarginal series of black and green spots; the area between these two rows of spots olivaceous; a marginal series of conical black spots; fringe pinky white at the base; secondaries grey, becoming smoky brown towards the outer margin, fringe pure white; head, collar, and tegulæ sap-green, black-spotted; remainder of body greyish, with testaceous anal tuft: under surface greyish brown; wings sericeous with a dark transverse discal stripe; primaries with

pale-yellowish costa, internal area silvery grey; secondaries with white fringe. Expanse 2 inches 4 lines.

Hakodaté (*Whitely*).

Allied to *E. herbida*, much larger and brighter in colouring, and with no trace of the white patch beyond the reniform spot.

PLATAPLECTA, n. gen.

General aspect of *Aplecta nebulosa* (*Mamestra* of Grote), but with much shorter and broader wings, shorter body, and longer and less densely clothed palpi. Type *P. soluta* (*Polia soluta*, Walker).

110. *Plataplecta subviridis*, n. sp.

Primaries silvery grey (or white densely irrorated with grey), with blackish and white markings, nearly as in *Aplecta nimbosa*; the whole wing, but especially the basal area, indistinctly blotched with pale green; costal margin blackish, spotted with white near the apex; reniform spot subquadrate, black-edged; two transverse black-edged white stripes across the base of the interno-median area, a third connecting the first median branch with the inner margin, and followed by a large black spot; a very irregular greenish and white submarginal stripe bounded internally by conical black spots; apex blackish; a marginal series of black spots; fringe brown; secondaries pale brown, with darker outer border, blackish marginal line, and whitish fringe; body corresponding in colour with the wings: under surface shining pale brown; costa of primaries white-spotted near apex; secondaries whitish, with the discocellulars and outer border dusky; venter whitish. Expanse 1 inch 6–7 lines.

Yokohama (*Jonas*).

The male is lighter in colour than the female.

111. *Hadena gnoma*, n. sp.

Close to *H. atriplicis*, but much larger and darker, the primaries of a slaty-grey colour, varied with black and brown and *bright green* markings, arranged as in *H. atriplicis*, the bifid white spot less pure in colour and rather larger: secondaries, abdomen, and under surface altogether darker than in *H. atriplicis*. Expanse, ♂ 1 inch 10 lines, ♀ 2 inches 2 lines.

Yokohama (*Jonas*).

112. *Hadena lucia*, n. sp.

Allied to *H. atriplicis*, but differing as follows:—primaries above with an abbreviated white band from the costa to

the middle of the interno-median interspace (instead of the bifid white spot at base of first median branch); greenish markings paler and clearer; the apical border white, the black marginal spots less depressed and less distinct from the brown spots on the fringe; the other dark markings less sharply defined; secondaries more sericeous, with the basal half decidedly whiter; abdomen paler. Expanse 1 inch 11 lines.

Hakodaté (*Whitely*).

Xylinidæ.

113. *Auchmis intermedia* (*Cloantha intermedia*, Bremer).

Allied to *A. perspicillaris* and *A. sikkimensis*, pattern of the latter, but rather larger and paler, the basicostal and discoidal region of the primaries lilacine greyish, and the internal area tinted with the same colour: wings below paler, the costal margin of primaries and the ground-colour of secondaries white, the red-streaked areas of a duller tint. Expanse 1 inch 7 lines.

Hakodaté (*Whitely*); Yokohama (*Jonas*).

This is doubtless the Japanese representative of *A. perspicillaris*, just as *A. sikkimensis* is the Darjeeling representative; a fourth species of the same type occurs at Natal.

114. *Calocampa fumosa*, n. sp.

Closely allied to *C. exoleta*, but altogether of a more smoky tint, the markings less distinct, the discoidal spots of primaries more quadrate, the two hastate black spots more elongated; the secondaries dark grey, the base pale brown, the fringe pale grey; head and collar whity brown, broadly bordered with piceous; thorax blackish; shoulders sordid white; abdomen whity brown, with confused dorsal and transverse dusky stripes. Expanse 2 inches 8 lines.

Yokohama (*Jonas*).

The primaries are rather more elongated than in the European species.

115. *Calocampa formosa*, n. sp.

Primaries shining grey, the costal area, outer half of disk, external border, and fringe suffused with laky brown; discoidal spots outlined in black, the reniform dark grey, with a central rounded spot, both edged with reddish and black; two central transverse undulated black lines, the outer one bordered externally by brown spots, which fill the sinuations; inner part of discal area whitish, followed by a sinuous series of black dots; external area cut off abruptly by an oblique

line from the costa near apex, continuous with a broad transverse plum-coloured streak, intersected by a pale line; submarginal area whitish; a series of black marginal spots; costal margin (almost to apex) black, white-spotted beyond the cell: secondaries brown, with dusky outer border; fringe sordid white, intersected by a dusky line: body nearly as in the preceding species. Wings below darker than in the other species of the genus, with well-defined blackish undulated marginal lines on a narrow pale border; secondaries with a broad regular dusky discal belt. Expanse 2 inches 2 lines.

Yokohama (*Pryer* and *Jonas*).

116. *Xylina pruinosa*, n. sp.

Primaries above shining silvery grey, with indications of a paler irregular transverse discal band; the base of the cell, three blackish-edged discoidal spots, an oval patch near the base on the interno-median interspace, and a small round spot (black-edged externally) paler grey; a submarginal row of black dots, a marginal undulated dark line; fringe irrorated with white: secondaries sordid white, the apical area and outer border broadly grey; fringe testaceous at the base, tipped with white, grey in the centre: thorax grey, speckled with testaceous and white; abdomen pale greyish or sordid white, with a darker dorsal line and a rosy brownish fringe. Wings below shining silvery whitish, with opaque brown-speckled costal borders to all the wings and outer border to primaries; secondaries with a dusky dot at the end of the cell; body rosy brownish. Expanse 1 inch 5 lines.

Yokohama (*Pryer* and *Jonas*).

Nearly allied to *X. rhizolitha*, but greyer, with much paler secondaries.

In my opinion the genus *Aporophylla* ought to be placed either with or close to *Xylina*; so far as I have been able to discover, it agrees in structure with *X. rhizolitha*. The main differences which Stainton gives to distinguish the Apamidæ from the Xylinidæ are that the imagines of the first family have the wings "in repose roof-shaped," and those of the second family "folded in repose;" the genera *Aporophylla* and *Xylina* are distinguished by the larvæ of the first feeding "on low plants," and those of the second "on trees." Characters such as these, which can be ascertained only by the field-naturalist, should surely not weigh so heavily as to separate two insects so similar as *Aporophylla australis* and *Xylina rhizolitha* by 81 pages. I presume that, notwithstanding the rarity of *A. australis*, it is known to close its wings like an *Apamea*.

117. *Xylina arctipennis*, n. sp.

Primaries silvery grey, the base, a central irregular black-edged band, a transverse discal stripe, and the outer border rather paler and greyer than the rest of the wing; a black dot at the base, a second at the inferior angle of the cell, a disco-submarginal series, a series of marginal black lituræ, and a short oblique black apical line; fringe intersected by a slightly darker line: secondaries shining sordid white, with a broad, pale brown external border; fringe white: thorax greyish brown, antennæ ferruginous; abdomen paler, whitish at base, with a black dorsal tuft. Primaries below pale shining brown, becoming silvery whitish towards the inner margin; costa beyond the cell dotted with black and whitish: secondaries silvery white, with a whity brown costal spot and a discal stripe of the same colour; pectus creamy white, changing to smoky brown in front; venter testaceous. Expanse 1 inch 7 lines.

Yokohama (*Jonas*).

118. *Lithophane saga*, n. sp.

Primaries grey, with a number of black and brown dashes, four in the centre of the costa, oblique, two near external angle also oblique, but slanting upwards, the remainder longitudinal; a dusky oblique streak from the outer margin near the apex to the external third of the inner margin; reniform spot barely distinguishable; an acutely undulated oblique discal line arched towards the costa, the external undulations filled in at the end by black spots: secondaries with the basal half sordid white, crossed by brown veins, external half occupied by a very broad smoky brown border, upon which the veins look black; fringe sordid white: head grey, with black spots behind the eyes; collar brown, with a central transverse black-edged grey belt; thorax grey, brownish and crested down the centre; tegulæ grey, with a brown streak on each side; abdomen whity brown, with dark brown dorsal tufts. Primaries below smoky brown, the basal area and apical border pale; secondaries white, the costal area and outer margin sordid; a broad brown external band, a black spot at the end of the cell, and a discal series of black dots on the veins; pectus pale greyish; venter sordid white. Expanse, ♂ 2 inches 4 lines, ♀ 1 inch 11 lines.

Yokohama (*Jonas*).

L. saga is allied to the "*Xylina indicatura*" of Walker.

119. *Cucullia fraterna*, n. sp.

Nearly allied to *C. lucifuga*, but the primaries duller, with

the spot in the cell black, compressed and elongated; secondaries pure white (with the veins and outer border brown, and the costal area brownish, as in *C. lucifuga*). Expanse 2 inches 1 line.

Hakodaté (*Whitely*).

Heliothidæ.

120. *Heliothis adaucta*, n. sp.

Close to *H. dipsacea*, but much larger, the primaries and thorax of a more sandy whitish tint, with the markings rather darker; the secondaries whiter with blacker markings, the spot closing the cell broader: body less reddish in tint; under surface with all the markings much more distinct. Expanse 1 inch 5–6 lines.

Yokohama (*Jonas*); Hakodaté (*Whitely*).

The largest examples of *H. dipsacea* measure about 1 inch 3 lines in expanse.

Erastridæ.

121. *Erastria stygia*, n. sp.

Allied to *E. fuscula*: primaries black in the male, brown in the female, with darker bands and lines as in *E. fuscula*, the orbicular and reniform spots more or less strongly outlined in white; costa white-spotted, most strongly beyond the middle, a more or less strongly defined squamose patch of yellowish scales just beyond the reniform spot; a transverse bracket-like white line followed by a yellowish streak near the external angle; a Ʒ-shaped pale line, bordered outwardly with deep black, near the base; fringe of all the wings white-spotted and with basal and central pale lines: secondaries shining greyish brown. Wings below much as in *E. fuscula*, but darker. Expanse 1 inch 1 line.

Yokohama (*Jonas*).

Although allied to *E. fuscula*, this species has more nearly the aspect of *E. africana* of Felder: excepting in the form of the margin of the secondaries, it nearly approaches *Eriopus Latreillii* of Duponchel.

Anthophilidæ.

122. *Anthophila paradisea*, n. sp.

Allied to *A. purpurata*: primaries with the basal half pale lemon-yellow, white at base of inner margin; disk bright rose-colour, whitish on the costa near apex, and indistinctly blotched with pale bronzy brown (barely visible without a

lens); outer border bronzy brown, bounded internally by a series of white dots; fringe bright rose-colour: secondaries pale brown; fringe white, tipped with rose-colour: head and thorax lemon-yellow, abdomen white. Primaries below pale greyish brown, with whitish borders; base of costa and outer half of fringe rose-colour; secondaries white, fringe tipped with pink; pectus white; legs and palpi rose-coloured externally; venter greyish. Expanse 1 inch 2 lines.

Yokohama (*Jonas*).

Eriopidæ.

123. *Callopistria obscura*, n. sp.

Allied to *C. pteridis*, but the ground-colour of the primaries sepia-brown, more or less irrorated with tawny, the transverse lines wider apart and bordered by sericeous grey (not rosy lilacine), the veins whiter, the marginal spots narrower and blackish; secondaries rather paler than the primaries, with whitish costal area and outer border; body altogether duller and greyer than in *C. pteridis*: primaries below grey, with sandy whitish borders; secondaries sericeous whitish, with greyish subapical patch or spot, discal line, and discocellular spot; body below sandy whitish. Expanse 1 inch 5 lines.

Hakodaté (*Whitely*); Yokohama (*Jonas*).

Altogether darker and less red than *C. pteridis*.

124. *Callopistria æthiops*, n. sp.

Allied to *C. exotica* from Java, but the primaries almost black, crossed by silvery white lines, the oblique white-edged dash at the end of the cell tapering downwards to a point and almost uniting with the interno-median band, which is oblique, the band across the cell also well-marked and oblique, so that the three markings together make a γ; the white apical dash represented by three decreasing oblique white lines, the lowermost of which joins a ≶-shaped white figure (replacing the lanceolate mark of *C. exotica*); outer border narrow, black, edged with white: secondaries silvery whitish, the veins, an indistinct abbreviated discal line, and a broad diffused outer border greyish: body whitish, collar banded with black; base of tegulæ testaceous, anal tuft ochraceous. Wings below silvery whitish; primaries with the discoidal area, and two white-bordered discal streaks greyish; secondaries with the discocellulars and two apical streaks parallel to the outer margin greyish brown; body whitish. Expanse 1 inch 1 line.

Yokohama (*Jonas*).

Walker confounded two distinct species from Java and a third from Canara under *C. exotica.* *C. æthiops* is close to "*Plusia duplicilinea*" from Borneo.

Placodidæ.

SCEDOPLA, n. gen.

Nearly allied to *Placodes*, but differing in its distinctly pectinated antennæ, the shorter terminal joint of the palpi, and the subcostal branches of secondaries emitted from a rather long footstalk. Type *S. regalis.*

125. *Scedopla regalis*, n. sp.

Primaries with the basal two thirds dark brown, shot with purple, external third of a dead golden or deep sandy yellowish colour; a broad subcentral transverse band indicated by marginal sinuated limiting lines of black; a black litura at the end of the cell; the disk slightly darker than the outer border, its limit barely visible excepting at costa, sinuated; a submarginal series of minute black dots: secondaries stone-colour; costa white; outer margin and fringe sandy whitish; a series of dusky marginal lituræ: body brown, abdomen greyish. Under surface sandy yellowish; wings with a grey discal line; primaries greyish, excepting at the borders. Expanse 1 inch 3 lines.

Yokohama (*Jonas*).

Plusiidæ.

126. *Plusia typinota*, n. sp.

Allied to *P. gamma*, but the γ-mark more elongated, three other silvery characters, somewhat resembling *I, J, K*, but with the *J* sloping backwards, across the costal and discoidal areas; the margins of the central band rather silvery than golden; outer border of secondaries and borders of all the wings below ill-defined. Expanse 1 inch 9 lines.

Yokohama (*Jonas*).

127. *Plusia jessica*, n. sp.

Allied to *P. ni*, but the primaries darker and more sericeous; instead of the central silvery markings a brassy γ; the discal line rather less irregular; the edge of the outer border rather more irregular, more uniform in tint; a marginal series of pale-edged triangular black spots instead of the marginal lines; fringe almost rubbed away in the type; secondaries greyer, without the abruptly darker border; thorax darker: wings

below greyer, without the paler border. Expanse 1 inch 4 lines.

Yokohama (*Jonas*).

128. *Plusia purissima*, n. sp.

Allied to *P. parilis*, but larger, greyer, more sharply defined, more sericeous; primaries more acuminate; the lower half of the external area and a broad oblique streak from the apex to the end of the cell silvery whitish; transverse band much more oblique, the limiting lines sharply defined, black, with pinkish white external edge; the silvery γ replaced by two silvery spots; the submarginal line straight to the third median branch and then gently angulated, terminating before the apex; a marginal piceous and white streak, not reaching the external angle: secondaries pale brown, becoming darker towards the outer margin; two ill-defined dusky discal lines: head, collar, and thorax grey, with red-brown posterior transverse bands; abdomen brownish grey, with a red-brown dorsal tuft near the base. Under surface sericeous grey, with two parallel discal darker lines; secondaries with the basal half whitish. Expanse 1 inch 5 lines.

Yokohama (*Jonas*).

129. *Plusia mikadina*, n. sp.

Nearly allied to *P. concha*, but rather paler, the golden ⊂-shaped marking of primaries replaced by a larger brassy ⊂⊃; the outer or discal line more deeply sinuated, and the golden patch bounded by it on the inner margin of double the width, all the golden patches paler; the discoidal spots narrower and more angular: wings below much paler, the discal streaks wider apart, the outer one of primaries more strongly angulated. Expanse 1 inch 7 lines.

Hakodaté (*Whitely*); Yokohama (*Jonas*).

Calpidæ.

130. *Calpe excavata*, n. sp.

Form of *C. thalictri*, excepting that the inner margin of the primaries is more deeply excavated and more widely lobate. More nearly allied to *C. rectistria*, but the primaries of a richer reddish brown, the golden patch from the external angle upwards is wanting, the double oblique line from the apex separates more widely and becomes more irregular near the inner margin, outer margin subangulated below the middle; the secondaries differ in their dull sandy-brown colour, with broad diffused fuliginous external border; head and thorax

orange and red-brown, tinted with lilacine, as in *C. rectistria*; abdomen fuliginous: primaries below rather redder; secondaries yellower, with black discocellular lunate marking, a dusky discal streak; discal area from the streak greyish, excepting at apex. Expanse 2 inches 1 line.

Yokohama (*Jonas*).

C. rectistria is erroneously referred by Guénée to his genus *Oræsia*.

131. *Calpe sodalis*, n. sp.

Closely allied to *C. thalictri*, but differing in its paler colouring and the colour and shortness of the fringe, which is uniform with the ground-colour of the wings instead of being dusky; primaries below with darker discal streaks, secondaries with the discocellular litura and discal streak paler. Expanse 1 inch 10 lines.

Hakodaté (*Whitely*); Yokohama (*Jonas*).

132. *Deva splendida*, n. sp.

Aspect of *Oræsia emarginata*, but with the palpi longer, more slender, and recurved over the head; in coloration more like *O. provocans*; primaries above greyish brown, speckled here and there with black, streaked with shining lilac; central area ferruginous, shading into ochraceous, and thus resembling a bright cupreous lustre, with which the external area is shot; a bisinuated basal litura, a &-shaped marking above the median vein, a discal streak, the outer margin, the inner edge of the outer border at apex, and the outer border of external angle lilacine; a line from below the cell and irregular discal line silvery; a bright silvery marking (somewhat resembling a *v* in writing) at the base of the first median branch; reniform spot constricted, feebly outlined with lilacine: secondaries shining brown, with two darker central streaks; fringe tipped with whitish: head and collar testaceous, banded with lilac; thorax darker, also banded with lilac; abdomen greyish, whitish at base, with a lilac-tipped black and ochraceous dorsal tuft. Under surface not unlike that of *Oræsia emarginata*, but the primaries and the disk of secondaries darker; the latter wings also with a well-marked arched discal stripe; legs greyish; tarsi blackish, banded with whitish. Expanse 1 inch 7 lines.

Hakodaté (*Whitely*).

Gonopteridæ.

133. *Gonitis commoda*, n. sp.

Most nearly allied to *G. fulvida*, but larger and darker, the

primaries redder, the lines darker and less strongly undulated, the central line straight, the fringe less deeply white-tipped; secondaries with much less white on the fringe: wings below darker, the lines darker, the discal line of secondaries carried across the wing, as in *G. combinans*. Expanse 1 inch 10 lines.

Yokohama (*Jonas*).

G. fulvida (*Anomis fulvida* of Guénée) is a native of Java and the Andamans; we have also an example labelled "North India." Walker confounded a larger Indian species with it; but the latter is scarcely distinguishable from his own *Gonitis revocans* from Australia.

[To be continued.]

XXV.—*Further Notes on the Structure of* Peripatus novæ-zealandiæ. By F. W. Hutton, Professor of Zoology in the University of Otago.

During the last three months I have dissected several more specimens of *Peripatus novæ-zealandiæ*, with the advantage of Mr. Moseley's paper before me; and I hasten to communicate the results, because I wish to correct several errors into which I have fallen, and to confirm, as soon as possible, Mr. Moseley's statement of the existence of male individuals.

Integumentary System.—The last joint of the legs consists of a short subcylindrical joint, on the upper and outer margin of which are three large papillæ, and below two large curved simple claws. On the fourth and fifth pairs of ambulatory legs there is a circular opening in the centre of the inner side of the first, or inner, tarsal ring—that is, on the fifth ring from the end. I am, however, doubtful whether the tarsi should not be considered four-ringed only.

Muscular System.—My supposed "salivary bags" (see Ann. & Mag. Nat. Hist. 1876, xviii. p. 364) are the same as Mr. Moseley's "retractor muscles of the head" (see Phil. Trans. vol. 164, pl. lxxii. fig. 1, *rm*). Mr. Moseley is right in calling them muscles; my mistake arose from believing the tracheæ on them to be internal instead of external. They are, however, the flexor or adductor muscles of the teeth. The pairs of teeth are not moved simultaneously. Generally their movements are alternate, but often one pair is moved several times, while the other is stationary; there is also a movement by which the two teeth of a pair are separated and approximated. The two pairs of teeth, when in use, sometimes touch each other at the tips; but they never cross.

Segmental Organs?—These are what I previously called "salivary vessels." They form a series, on either side, unconnected with each other, but running into each leg, with the exception of the first three pairs. Each consists of a trunk coming out of the leg, which divides into two; and these branches, after several foldings, unite together, thus forming a closed loop. They are filled with colourless granulated cells. They were regarded by H. Milne-Edwards as nerves passing into the legs (Ann. des Sci. Nat. 2ᵉ sér. xviii. p. 128*); but I have carefully dissected some out, and find that they have no connexion with the nerve-cord; and I also feel confident that they do not open into the body-cavity. Consequently I do not feel sure that they should be considered segmental organs.

Slime-ducts.—These pass from the oral papillæ along the back to about the centre of the body; they then turn forward and throw off branches; they then turn backward again, and reach nearly to the posterior end of the body. They are probably homologous with the supposed segmental organs.

Respiratory System.—I think Mr. Moseley is right in considering my "spiral fibres" tracheæ; but then all resemblance to the tracheæ of insects vanishes. Professor Ray Lankester is probably right in considering that the tracheal systems in *Peripatus* and in insects have been independently developed (Quart. Journ. Microsc. Sci., Oct. 1877, p. 439).

Circulatory System.—I have succeeded in dissecting out the dorsal vessel; it contains a greenish-yellow fluid. Mr. Moseley is certainly incorrect in denying the existence of the "lateral canals" of Grube. It is satisfactory to me to think that I had demonstrated them before I knew that they had been previously described. Whether they belong or not to the circulatory system may perhaps be considered an open question; but they contain, especially at the anterior end, a yellowish-green fluid like that in the dorsal vessel.

Reproductive System.—By selecting small individuals I have succeeded in finding two males. Mr. Moseley's description of the male organs is very accurate; but they lie above the alimentary canal, and not below it. With the exception of these two specimens, all the rest were what I consider to be hermaphrodite. They all had the organs described by me as testes; but in one individual the testis was absent on one oviduct, but present on the other. In the early spring (September) these contained no spermatozoa; but in November they were abundant. During all this time the oviducts were crowded with

* It is astonishing what a very full and accurate knowledge of the anatomy of this animal M. Milne-Edwards obtained by the dissection of one badly preserved specimen.

embryos, which would prevent any spermatozoa finding their way up from the vulva. This and the fact that the embryos in an oviduct are always (at least in my experience) in different states of development, convince me that the organs in question are testes, and not *receptacula seminis*, which is also contradicted by their cellular structure. The oviduct proceeds from the posterior end of the ovary, and not from the anterior end as shown in Mr. Moseley's figure. It also lies above the intestine, and not below it.

My observations of the development of this animal are not yet sufficiently extended for publication; but up to the present I have seen nothing to make me alter my views or accept those of Mr. Moseley.

Dunedin, Dec. 16, 1877.

XXVI.—*On the Genus* Palæacis, *and the Species occurring in British Carboniferous Rocks.* By R. Etheridge, jun., F.G.S., and H. Alleyne Nicholson, M.D., D.Sc., &c.

[Plate XII.]

1. *History of the Genus and Species.*

In 1836 the late Prof. Phillips, F.R.S., described a peculiar and anomalous coral, to which he gave the name of *Hydnopora? cyclostoma** ; but, beyond the few words which form his diagnosis, he offered no remarks. It is needless to say that the coral in question has no affinity with the genus *Hydnopora*, a fact which Phillips himself appears in some degree to have surmised. Following in the footsteps of Phillips, M'Coy, in 1844, described his *Astræopora antiqua*†, and pointed out its close relationship with *Hydnopora? cyclostoma*, Phill.; indeed he considered the two might be congeneric, although specifically distinct, and he further indicated that the name *Astræopora* was more appropriate than *Hydnopora*. The same author in 1849, in a paper, "On some new Genera and Species of Palæozoic Corals and Foraminifera"‡, gave Hook Point as the locality of his species.

Messrs. Milne-Edwards and Jules Haime, in their magnificent work 'Polypiers Fossiles des Terrains Paléozoïques,' refer *H.? cyclostoma*, Phill., and *Astræopora antiqua*, M'Coy, with some doubt, to their genus *Propora* §, with the remark

* Geol. Yorkshire, ii. p. 202, pl. 2. figs. 9 and 10.
† Synop. Carb. Foss. Ireland, p. 191, pl. 26. fig. 9.
‡ 'Annals,' 2nd ser. vol. iii. p. 133. § Pp. 224, 225.

"ne paraît pas en différer" (*i. e.* the two species). However, in their 'Monograph of the British Carboniferous Corals'*, all doubt on the subject appears to have left their minds; for they there consider the two as identical, under the one name *Propora? cyclostoma*. So far as we have been able to ascertain, no further effort towards the elucidation of these fossils was made for some time; but in 1860 Milne-Edwards described, in the third volume of the 'Histoire Naturelle des Coralliaires'†, a genus established by Jules Haime shortly before his death, but never described by him, under the name of *Palæacis*, containing a single species, *P. cuneiformis*‡, from the Carboniferous rocks of Spergen Hill, Indiana. The genus is thus described:—"Polypary free but composite, rounded and very compressed at its base. Calices disposed, one at the summit, and the others in pairs upon the two lateral margins. Cœnenchyma finely vermicular." It is provisionally assigned to the Madreporidæ, subfamily Turbinarinæ. The chief points brought out in the specific description are the cuneiform nature of the corallum, the presence of from two to five calices, each occupied by thirty or forty fine unequal striæ representing the septa, two of which are both described and figured as being stronger than the others.

About the same time Messrs. Meek and Worthen had under observation similar fossils, to which, in a paper entitled "Descriptions of new Carboniferous Fossils from Illinois and other Western States"§, they applied the name of *Sphenopoterium*, and considered them to be corals allied to *Cyathoseris*, Edw. & H.; they, however, remark that they differ in having the outer wall perforated, and in the absence of distinct septa, as well as in the peculiar wedge-like form of the base of the corallum, which is usually, if not always, free instead of being attached. In their generic description of *Sphenopoterium*, Meek and Worthen state that the cells are large and inseparable, and increase by lateral and interstitial development; there are no tabulæ, columella, or well-developed rays; but the walls are merely marked by distinct striæ, and pierced by numerous pores which appear to terminate in the porous substance of the corallum. They describe four species—*S. obtusum* (the type), *S. compressum*, *S. enorme*, and *S. cuneatum*. It stands to reason, from their remarks and comparison with *Cyathoseris*, that they considered *Sphenopoterium* to be a member of the Madreporaria Aporosa, family Fungidæ.

* P. 152. † P. 171.

‡ *Loc. cit.* pl. E. 1. f. 2.

§ Proc. Acad. Nat. Sciences Philadelphia for 1860, pp. 447, 448.

In 1866 the same authors redescribed * their genus *Sphenopoterium*, abandoned its Actinozoal affinities, and, upon the authority of Prof. A. E. Verrill, referred it to the sponges as remotely allied to some of the Jurassic forms. The obscure striæ seen on the interior of the "cups" of their specimens are again mentioned; but their septal character is abandoned. To the already known species they here added a new variety, *S. enorme*, var. *depressum* †:

We now arrive at a most important point in the history of *Palæacis* and *Sphenopoterium*. In the same year (1866) Von Seebach of Göttingen published, in the 'Nachrichten der königlichen Gesellschaft der Wissenschaften zu Göttingen' for 1866 ‡, a paper, "Die Zoantharia perforata der paläozoischen Periode," in which he demonstrated, amongst other things, the identity of the two genera, and adopted Haime's name §. This excellent paper was republished with figures in the 'Zeitschrift der deutschen geologischen Gesellschaft' for 1866 ||. Von Seebach considered, from his own researches, that *Palæacis* (= *Sphenopoterium*) was a true Zoantharian of the section Madreporaria Perforata, thus being in accord with Milne-Edwards, but differing from the first opinion of Meek and Worthen. Again, he demonstrated the identity of *Palæacis cuneiformis*, Edw. & H., with *P.* (*Sphenopoterium*) *cuneatum*, M. & W., and concluded his paper with a diagnosis of all the American species, describing two additional ones—*P. cymba*, v. Seebach, and *P. umbonata*, v. Seebach ¶. The latter were figured in the 'Zeitschrift' for 1866 **.

Yet another contribution bearing on this subject appeared in 1866. Herr Ludwig published a very remarkable paper in the 'Palæontographica' ††, entitled "Corallen aus paläolithischen Formationen," apparently having for its chief object the complication of synonymy by the introduction of a cloud of unusually long and unnecessary names. He described as *Ptychochartocyathus laxus* ‡‡ a form which Prof. de Koninck, later on, placed as a synonym of *Palæacis cyclostoma*, Phill. The description appears to bear out this view, although the figure, to our minds, is less satisfactory. Ludwig, however, noticed a character very well marked in all our Scotch examples of *Palæacis*—the concentrically wrinkled or ridged base; and he further noticed the papilla-like form of the so-called

* Illinois Geol. Survey Report, vol. ii. p. 145.
† *Loc. cit.* p. 146. ‡ Pp. 235–243. § P. 240.
|| Vol. xviii. pp. 304–310, t. 4.
¶ Nachrichten, pp. 241, 242. ** Pl. 4. figs. 3, 4.
†† Vol. xiv. 1865–66, pp. 133–244.
‡‡ P. 331, t. 69. fig. 2, *a*.

septal striæ, a feature which will be entered on more fully in our own remarks on this genus.

Another excellent paper on *Palæacis* was that by Dr. Kunth, "Korallen des schlesischen Kohlenkalkes"*.

Dr. Kunth agreed with Von Seebach as to the identity of *Palæacis* and *Sphenopoterium*; but he believed the determination of the systematic position to be a matter of some difficulty, although he ultimately agrees with Edwards and Von Seebach as to its being a member of the Madreporidæ, but differs from them as to the subfamily to which the genus should be referred. He very justly observes that, from the figures given by various authors, there appears to be no proper cœnenchyma in *Palæacis*, and would place it in the subfamily Eupsamminæ, having its nearest ally in *Astroides*; indeed, he adds, its resemblance to *A. calycularis*, Pallas, is very great, only the latter has a columella and more strongly developed septa†. By far the most important point brought forward by Kunth was the determination of mural pores, visible when the surface was worn, with an irregular direction and disposition, and corresponding to canals which traverse in every direction the substance of the skeleton, giving to it a spongy appearance, and placing the various cups in connexion with one another‡. Dr. Kunth gave a detailed description and figure of *Ptychochartocyathus laxus*, Ludw., which he considered to be a species of *Palæacis*, from its general structure, external granulated surface, basal attachment, and the cup-like openings with circular mouths, and separated from one another by shallow depressions, &c. The determination of species in *Palæacis*, Kunth considers to be a difficult matter, from the few striking characters presented by the specimens. The external form is so open to modification from age, position, and condition of life, that little reliance can be placed on this. He confirmed von Seebach's union of the two species, *P. cuneiformis*, Ed. & H., and *P. cuneata*, M. & W., and further expressed his opinion that von Seebach's own species, *P. cymba* and *P. umbonata*, and *P. obtusa*, M. & W., may, in reality, represent only one species §, an opinion in which we quite concur.

Prof. L. G. de Koninck has devoted much attention to this genus; for in his 'Nouvelles Recherches sur les Animaux Fossiles du Terrain Carbonifère de la Belgique'‖, a lengthened description is given, accompanied by copious notes on its history and structure. The observations of Kunth on the

* Zeit. deutsch. geol. Gesellsch. xxi. pp. 183–220.

† *Loc. cit.* p. 187.

‡ *Loc. cit.* pp. 185, 186.

§ *Op. cit.* p. 188.

‖ 1re partie, pp. 154–161 (Bruxelles, 1872, 4to).

structure and position of the pores perforating the substance of *Palæacis* are confirmed. A point upon which Dr. Kunth appears to have had some doubt, the presence or absence of a columella, is also set at rest by De Koninck, who proved the entire absence of this structure. Milne-Edwards, in his description of *P. cuneiformis*, mentions the presence of two large septa, which Prof. de Koninck does not appear to have met with in the specimens he had examined. He also agreed with Dr. Kunth that, contrary to the opinion of Haime, there is no independent cœnenchyma in *Palæacis*; and, in consequence, the genus was removed to the Eupsamminæ, after Kunth; but, unlike the latter, De Koninck would not place it near *Astroides*, but probably between *Cœnopsammia* and *Stereopsammia*, the latter, like *Palæacis*, being devoid of a columella.

Including in this genus the two forms mentioned in the first two paragraphs of this paper (*Hydnopora? cyclostoma*, Phill., and *Astræopora antiqua*, M'Coy), Prof. de Koninck would reduce the number of known species to four, viz.:—

1. *Palæacis cuneiformis*, J. Haime.
=*Sphenopoterium cuneatum*, M. & W.

2. *Palæacis* (*Sphenopoterium*) *compressa*, M. & W.

3. *Palæacis* (*Sphenopoterium*) *obtusa*, M. & W.
=*Palæacis cymba*, v. Seebach; *Palæacis umbonata*, v. Seebach.

4. *Palæacis cyclostoma*, Phillips.
=*Sphenopoterium enorme*, M. & W.; *Ptychochartocyathus laxus*, Ludw.; *Astræopora antiqua*, M'Coy.

In 1873 one of the present writers (R. E., jun.) published a few remarks on the occurrence of this genus in Scotch Carboniferous beds, in the 'Memoirs of the Geol. Survey of Scotland' *. It was shown that specimens of *Palæacis cyclostoma*, Phill., from Mid-Lothian usually possessed from five to nine cups; an entire absence of columella was remarked upon, and some other minor points were noticed †.

One of the latest notices of *Palæacis*, of which we have any knowledge, is a short account of the discovery of the typical species of the genus in Britain—*P. cuneiformis*, J. Haime (=*P.* (*Sph.*) *cuneata*, M. & W.)—by Mr. Spencer G. Perce-

* Explanation to sheet 23 (1-inch, Scotland), p. ---.

† In these remarks I published what I then believed to be a new variety of *Palæacis compressa*, M. & W., under the name of *irregularis*. I now find I was much mistaken in the affinities of the bodies so called, and am desirous of withdrawing the name from palæontological science.—R. E.

val*, who obtained examples at Combe Down, near Bristol, from the Encrinital limestone, forming the upper bed of the Lower-Limestone shales.

Lastly, Prof. Ferdinand Roemer, in the explanation accompanying pl. xxix. of his 'Lethæa Palæozoica' (the text of which is not yet published), has a few remarks upon this subject. He expresses the opinion that *Palæacis*, E. & H., though identical with *Sphenopoterium*, Meek and Worthen, is not generically so with the group to which *Hydnopora cyclostoma*, Phill., belongs. The only difference that he mentions is that the corallum of the true *Palæacis* is regular and free, with a pointed base, while that of the second group is irregular and is attached to foreign bodies. As this second group cannot, of course, be referred to *Hydnopora*, Dr. Roemer retains for it the ungainly appellation of *Ptychochartocyathus*, Ludwig. We cannot, however, regard the evidence at present brought forward as sufficient to generically separate the two groups above referred to; for, omitting many weighty reasons for our opinion, to be more fully entered into further on, we would simply point out that Meek and Worthen were themselves in doubt whether some, at least, of their forms were free or attached. Dr. Roemer also mentions that a comparison of authentic specimens of both forms has satisfied him that *Palæacis laxa*, Kunth, is the same organism as *Hydnopora cyclostoma*, Phill.

Having given a history of this peculiar genus and its species as briefly as possible, it may not be out of place to recapitulate in a few words the order in which the various points in its structure were made out. Beyond briefly describing their respective forms, Phillips and M'Coy can be said to have contributed little towards the structural details of this interesting group, although Phillips certainly figured distinctly the vermicular nature of the external portions of the skeleton. We find that Milne-Edwards noticed the cuneiform appearance of the type species (a character which, by-the-by, is more or less traceable throughout almost all the species), the presence of what he considered to be numerous septa (of which two were thought to have been larger and more pronounced than the others), the supposed vermicular cœnenchyma, and the free habit. By Edwards *Palæacis* was referred to the Madreporaria Perforata. Almost simultaneously Meek and Worthen published their *Sphenopoterium*; and, bearing in mind their comparison of it with *Cyathoseris*, they must have concluded it be one of the Madreporaria Aporosa. They were

* Geol. Mag. dec 2, vol. iii. p. 267.

the first to notice the important character of the perforated walls; and they also remarked on the supposed septal system, with the absence of tabulæ and a columella. The next step, the double demonstration by Von Seebach of the identity of *Palæacis* and *Sphenopoterium*, on the one hand, and of the species *P. cuneiformis*, J. Haime, with *S. cuneatum*, M. & W., was a most important one. He also confirmed Milne-Edwards's reference of *Palæacis* to the Madreporaria Perforata. Admitting the *Ptychochartocyathus laxus*, Ludwig, to be a *Palæacis*, we find that Ludwig improved our knowledge of the supposed septal characters, and noted the presence of what he termed a basal concentric epitheca. Dr. Kunth confirmed the presence of the mural pores originally noticed by Meek and Worthen, and further showed that these pores led into a series of canals traversing the substance of the corallum, and placing the cups in connexion with one another. He likewise disputed the presence of any true cœnenchyma as supposed by Milne-Edwards, and left the matter of a columella an open question. Lastly, Prof. de Koninck confirmed Kunth's remarks on the mural pores of *Palæacis*, determined the absence of a columella, and supported Kunth's reference to the Eupsammidæ. We also believe De Koninck was the first to refer *Hydnopora? cyclostoma* and *Astræopora antiqua* to the genus *Palæacis*.

2. *Description of, and Observations on, the Genus.*

Genus PALÆACIS (J. Haime), M.-Edw. 1860.

Hydnopora, Phillips, Geol. York. 1836, ii. p. 202.
Astræopora, M'Coy, Synop. Carb. Foss. Ireland, 1844, p. 191; Morris, Cat. Brit. Foss. 1854, 2nd ed. p. 47.
Palæacis (J. Haime), M.-Edw. Hist. Nat. Corall. 1860, iii. p. 171.
Sphenopoterium, Meek and Worthen, Proc. Acad. Nat. Sci. Philad. (for October 1860), p. 447; iid. Illinois Geol. Surv. Rep. 1866, ii. p. 145.
Palæacis, Von Seebach, Nachr. d. k. Gesell. d. Wissensch. zu Gött. 1866, p. 240; id. Zeitsch. d. deutschen geol. Gesell. xviii. 1866, p. 308.
?*Ptychochartocyathus*, Ludwig, Palæontographica, 1866, xiv. pp. 189, 231.
Palæacis, Kunth, Zeitsch. d. deutschen geol. Gesell. 1869, xxi. pp. 186, 187; De Koninck, Nouv. Rech. Anim. Foss. Terr. Carb. Belgique, 1872, pt. 1, p. 154.

Gen. char. Skeleton more or less cuneate or irregularly turbinate in form, depressed, or with age becoming irregular, adhering, on the one hand, by the whole or part only of a concentrically wrinkled base, or, on the other, by a small peduncular extension of the skeleton. Cups variable in number, one to twelve and perhaps more, cell-like, opening up-

wards or laterally and sometimes obliquely, with circular or oval crenulate margins, not all on the same plane, separated from one another by shallow depressions. Base, in depressed forms, flat or somewhat concave; in cuneate or turbinate examples it is laterally compressed or prolonged downwards in the form of a small peduncle, usually concentrically ridged. Parts of the skeleton between the cups, and also the lower surface more or less, are covered with vermicular ridges or granules, and are often pierced by rounded or elongated pores of considerable size. Interior of the cups marked with a variable number of granules arranged in a more or less radiating manner, and pierced near their upper portions by similar apertures to those just mentioned. Structure, to the naked eye, when the skeleton is fractured, spongy. Microstructure, consists of a calcareous tissue, pierced, more or less extensively, by a system of microscopic tubuli, in parts compact, in others more or less vesicular or trabecular.

Obs. With the aid afforded by a particularly fine collection of what appears to be the commonest British species, *P. cyclostoma*, Phill., in conjunction with the characters of the other published species, we have been able to extend the generic diagnosis of *Palæacis*. So far as our researches have at present gone, we are acquainted with at least three well-defined species of *Palæacis* in British Carboniferous rocks; and it is upon the structure of these that our knowledge of the genus is based.

The surface in all the species of *Palæacis* seems to be more or less granular, or covered with vermicular striæ or ridges; but the precise appearance varies in different cases. In *P. cuneiformis* (Pl. XII. figs. 9–12) the surface is covered with numerous irregularly-curved, subparallel, sometimes bifurcating, vermicular ridges, placed about their own diameter apart. We have not satisfied ourselves that any large pores can be detected on the surface of examples of this species; but the summits of the ridges above alluded to appear to carry lines of small pores, now filled with calcite, and the entire substance of the skeleton has a fine spongy aspect. This appearance, however, is more noticeable in slightly rubbed specimens. In *P. obtusa* the surface-characters are the same as in *P. cuneiformis*. In *P. cyclostoma* the surface is covered with innumerable granules, small tubercles, and vermicular ridges, which do not show the same subparallel arrangement as in the two preceding species, but are disposed irregularly, or sometimes with a tendency to form lines. In many cases the surface of the skeleton between the cups is distinctly perforated with large rounded or oval pores, leading into the

interior; and similar pores are very often found in a very well-marked form on the lower surface of the colony. Though abundant on the margins of the cups, the pores seldom extend into the interior of these depressions; and the bottom of the cups does not appear to be ever perforated by pores. In other specimens, again, the surface appears to be destitute of the large pores just mentioned; but in all alike the general surface, as examined under the microscope, shows a spongy and minutely porous aspect, though it is difficult to determine positively whether this be really due to the presence of extremely fine pores or not.

In the interior of the cups the tubercles and vermicular ridges often have a distinctly linear arrangement, radiating from the centre of the cup, and form the so-called "septa." They certainly present a close resemblance to the septal striæ of many forms of *Cystiphyllum*, and a less close one to those of *Protaræa*; and if *Palæacis* is a true coral, they doubtless represent the septa. On the other hand they present an equally close resemblance to the surface-tubercles and vermicular ridges (also often in parts radiate) of various Stromatoporoids; so that little weight can be attached to this as deciding their true nature. In his figure of *P. cuneiformis* (Hist. Nat. des Cor. vol. iii. pl. E 1. f. 2 *b*) Milne-Edwards figures a principal pair of septa, placed opposite each other, as a longitudinal ridge dividing each cup into two halves. In his description of the species, however, he speaks of these septa with much doubt and hesitation, stating that the cups "paraissent avoir été partagés par deux grands cloisons, dont on ne voit plus que des traces fort obscures dans la direction de l'axe vertical du polypier." Prof. de Koninck appears to have regarded the pair of principal septa with much suspicion; and we can safely assert that they are not present in any example examined by us. The tubercles or papillæ forming these so-called septal striæ vary in size in the same individual, and even in the same line or septum. In all cases those occupying the floor of the cups are irregularly scattered, and do not appear to be arranged in any definite manner.

Micro-structure.—The intimate structure of *Palæacis* does not hitherto appear to have been investigated by means of thin sections prepared for the microscope. Our researches in this direction have been confined chiefly to *P. cyclostoma* (Pl. XII. figs. 7, 8), of which our material was most abundant, though we have also made a few sections of *P. cuneiformis* (Pl. XII. fig. 14). In the former of these two species the minute structure of the organism, as displayed by this method of examination, is as follows (Pl. XII. figs. 7, 8):—

Whether the sections are taken across the cups in a direction perpendicular to their long axes, or corresponding with these, the appearances presented are the same. In both cases the calcareous tissue of the skeleton appears to be penetrated by minute microscopic tubuli, which run at right angles to the cups, and which are much more largely developed and more conspicuous in some parts than in others. The layer which forms the immediate floor and walls of the cups is not lacunar or trabecular, but is traversed by innumerable minute tubules (Pl. XII. figs. 7, 8, *b*), which are directed outwards in a series of parallel bands, the tubules of each band having a more or less penniform disposition with regard to a central tubule. These tubules doubtless open on the floor of the cup; but their apertures are too minute to admit of recognition in any of our specimens. Apart from the layer which lines the cups, the rest of the skeleton is made up of a more or less open cellular or trabecular tissue (Pl. XII. figs. 7, 8, *c*), consisting of irregular lacunæ of various sizes, separated by calcareous partitions, but doubtless more or less freely communicating with one another. By the opening of these lacunæ upon the general surface are formed the large pores which are so commonly seen on the lower aspect of these fossils, and less often upon the upper surface as well. The calcareous partitions between these lacunæ are likewise minutely tubulated, though this structure is not nearly so well developed or so conspicuous as in the floor of the calices; and the tubules run directly across the partitions and thus place contiguous lacunæ in communication. Of *P. cuneiformis* our knowledge is not so complete; but the structure seems to be essentially the same (Pl. XII. fig. 14). The calcareous tissue of the skeleton is traversed by microscopic tubuli; but the general texture is more compact, and the trabecular tissue is but slightly developed, such lacunæ as are present being remote and separated by a considerable thickness of compact tissue. In some cases, also, there proceed from the depressions between the surface-ridges larger canals, which become gradually smaller as they pass inwards, and which do not appear to actually reach the interior of the cups.

Affinities.—Palæacis, as we have mentioned, has been generally regarded as a "perforate" coral; but the microscopic structure would completely bear out Prof. Verrill's view that it cannot be referred to the Actinozoa. It seems, on the contrary, to exhibit a minute structure which would place it somewhere amongst the Protozoa (including the sponges in this subkingdom), and which certainly cannot be paralleled among any of the true corals. The general reticulated struc-

ture of the greater part of the skeleton, and the vermicular granulation and ridging of the surface, give *Palæacis* a striking resemblance to some forms of the Stromatoporoids; but none of the latter has as yet been shown to possess a *minutely* tubulated skeleton, and the cups of the former are likewise a unique feature in the genus. On the other hand, the microscopic tubulation of the skeleton reminds one to some extent of that of some of the Foraminifera.

If we were to take Meek and Worthen's view, founded upon that of Prof. Verrill, that *Palæacis* is a sponge, we should have to refer the genus to the Calcispongiæ, since the original constitution of the skeleton is undoubtedly calcareous. Its general structure, however, does not resemble that of any known calcareous sponge, so far as we are aware; and the tubulation of the skeleton also removes it from the Spongida.

In fact, if we regard *Palæacis* as referrable to the Calcispongiæ, it must, like the Stromatoporoids, be placed in a special division, since its skeleton is unquestionably reticulate and vermiculate, and no traces of *spicules* can be detected in it. Indeed, were it not for the minute tubulation of the skeleton and the presence of the cups, it would be difficult to lay down any decisive characters by which *Palæacis* could be separated from the Stromatoporoidea.

Our friend Mr. H. B. Brady, F.R.S., has been kind enough to examine a few specimens and sections of this interesting organism; and in his opinion there is nothing of a Foraminiferal character to be deduced from them; but, on the contrary, he appears to regard *Palæacis* as more probably allied to the Sponges. For our own part, whatever may be the ultimate result of a further investigation of this genus, we can simply state that we do not believe in its coral-affinities, and that there are many facts which tend to bear out the later view entertained by Meek and Worthen, suggested to them by Prof. A. E. Verrill, that *Palæacis* (= *Sphenopoterium*) is a sponge. The opinion of Mr. H. B. Brady is so decided that we are forced to abandon any thought of Foraminiferal affinities; and we can, for our own part, only say that, if not a sponge, we do not know where it can be placed. So many eminent authorities have regarded *Palæacis* as a coral, that we desire to treat their opinions with all due respect; but the total absence of any trace of a columella, or septa (for the so-called "septal striæ" can in no way be regarded as such), and the peculiar micro-structure compel us to dissent from this view of the case. We conceive that our opinion is borne out by the evident discrepancies which exist in the descriptions and remarks of previous writers on the subject, and also in the want of

unanimity amongst them as to the systematic position of *Palæacis* amongst corals. There is, however, one fact we must not omit to refer to. It was pointed out by Meek and Worthen that increase took place by interstitial development; we find that a kind of fission occurs in some of the cups of *P. cyclostoma* (Pl. XII. fig. 16); and we are inclined to regard this as one of the few characters present indicating any alliance with the Actinozoa.

We distinctly wish it to be understood, in closing this part of our remarks, that we by no means finally assert *Palæacis* to be a *sponge*, although we consider it has a much closer alliance with the latter than with the Actinozoa, so far as the researches we have at present undertaken enable us to judge.

With regard to the name this organism should bear, Von Seebach, Kunth, and De Koninck have all adopted *Palæacis* in preference to *Sphenopoterium*, on account, as they state, of the previous publication of the former. The third volume of the 'Hist. Nat. des Coralliaires' bears date of publication 1860, whilst that portion of the 'Proc. Acad. Nat. Sci. of Philad.' containing the description of *Sphenopoterium* bears at the foot of certain of the pages the date "October, 1860." If this represents the date of publication, as we believe it does, Meek and Worthen's name may have as good a claim for recognition as Haime's; and if the Protozoal character of the fossils known by these names come ultimately to be adopted, it will become a question if we should not rather make use of *Sphenopoterium* as the generic term.

Addendum.—The genus *Conopterium*, Winchell, is evidently very closely allied to *Palæacis*. We are, however, not sufficiently acquainted with it to enter into details on the subject. *Conopterium* was described by Prof. A. Winchell, in the Academy of Natural Sciences of Philadelphia ('Proceedings,' 1865, p. 110), as a coral, and its resemblance to *Sphenopoterium*, M. & W., pointed out.

3. *Description of the British Species.*

Palæacis cuneiformis (J. Haime), M.-Edw.

Palæacis cuneiformis (J. Haime), M.-Edw. Hist. Nat. Corall. 1860, iii. p. 171, Atlas, pl. E 1. f. 3.

cuneatum, Meek and Worthen, Proc. Acad. Nat. Sci. Philad. for Oct. 1860, p. 448; id. Illinois Geol. Surv. Rep. 1866, ii. p. 202, pl. 19. f. 1, *a–d*.

Palæacis cuneiformis, Von Seebach, Nachr. k. Gesellsch. Wissensch. zu Gött. for 1866, p. 241; id. Zeitschr. deutsch. geol. Gesellsch. 1866, xviii.

p. 308; De Koninck, Nouv. Rech. Anim. Foss. Terr. Carb. Belgique, 1872, 1e pt. p. 157 (without description); Perceval, Geol. Mag. 1876, dec. 2, iii. p. 267, (cut) p. 268.

Spec. char. Colony compressed, cuneate, longer than wide in the adult condition, more nearly pentagonal or hexagonal in the young state. Base more compressed than any other portion of the colony, sharp, but with rounded angles. Cups from two to five, but varying in number according to age, deep, conical, situated on the lateral margins and apex of the colony, and directed obliquely outwards and upwards; those at the apex are round or oval, those on the lateral margins are more or less elliptical. The granular ridges on the interior walls of the cups are slight and numerous. Perforations of the walls numerous and distinct. Surface marked with a multitude of fine, flexuous, broken, closely arranged, bifurcating vermicular ridges, directed obliquely inwards and downwards from the cup-mouths towards the base, where they become subparallel, and, from the presence of exceedingly minute and microscopic granules, assume a crenulate appearance.

Obs. For the discovery of this, the type species of the genus, in British Carboniferous rocks, we are indebted to Mr. Spencer G. Perceval, of Henbury, near Bristol. We have examined examples of this species in which the cups have been as few as two and as many as five, with intermediate forms bearing three and four respectively. When in its youngest state the colony is decidedly of a more or less triangular outline (Pl. XII. figs. 11, 12), gradually assuming a pentagonal and perhaps hexagonal form; and it is not until there are at least four cups present that the typical elongated cuneate form is assumed. Both Milne-Edwards and Messrs. Meek and Worthen mention the presence of two large "septa," the former author stating them to occur in addition to the regular series of between thirty and forty smaller "septa." The examples of this species with which we have worked have not been in such a state of preservation as to permit us to distinguish these above the remains of the other granular ridges. *P. cuneiformis* may be easily distinguished by its elongate compressed form (Pl. XII. figs. 9, 10), the lateral position of some of the cups, and its peculiar vermicular crenulate surface. From *P. cyclostoma* it may be at once known by the entire absence of the very characteristic basal concentric ridges of that species; and we are quite in accord with Von Seebach, Kunth, and De Koninck as to the identity of the *P. cuneiformis* of Haime and Edwards with the *Sphenopoterium cuneatum*, Meek and Worthen.

Under the observations on the genus we have given some

remarks on the minute external and internal structure, which need not be repeated here.

Locality and Horizon. Combe Hill, Henbury, near Bristol, in the upper beds of the Lower-Limestone Shales. Coed'y'gof quarry, near Wenvoe, by Cardiff, S. Wales.

Collector. Mr. Spencer G. Perceval: his Cabinet.

Other Localities. Spergen Hill, Indiana, U.S., in the St.-Louis Group of the Lower Carboniferous (*Milne-Edwards*, and *Meek and Worthen*).

Palæacis obtusa, Meek and Worthen.

Sphenopoterium obtusum, Meek and Worthen, Proc. Acad. Nat. Sci. Philad. for October, 1860, p. 448; id. Illinois Geol. Surv. Rep. 1866, ii. p. 233, pl. 17. f. 2, *a–c*.

?*Sphenopoterium compressum*, Meek and Worthen, Proc. Acad. Nat. Sci. Philad. for October, 1860, p. 448; id. Illinois Geol. Surv. Rep. 1866, ii. p. 234, pl. 17. f. 1, *a–c*.

Palæacis obtusa, P. cymba, et *P. umbonata*, Von Seebach, Nachr. k. Gesell. Wissensch. zu Gött. 1866, pp. 241, 242.

Palæacis obtusa, Von Seebach, Zeitschr. deutsch. geol. Gesellsch. 1866, xviii. p. 308.

Palæacis cymba, Von Seebach, Zeitschr. deutsch. geol. Gesellsch. 1866, p. 309, pl. 4. f. 4, *a, b*.

Palæacis umbonata, Von Seebach, Zeitschr. deutsch. geol. Gesellsch. 1866, p. 309, pl. 4. f. 3, *a, b*.

Palæacis obtusa, Kunth, Zeitschr. deutsch. geol. Gesellsch. 1869, xxi. p. 188; De Koninck, 1872, Nouv. Rech. Anim. Foss. Terr. Carb. Belgique, 1e pt. p. 158.

Spec. char. Colony "short, abruptly cuneate below, wider than high; basal edge slightly sinuous in the middle; flattened sides expanding rapidly upwards from the obtuse basal carina. Cells from four to about nine, comparatively large, and of moderate depth, conical, and, where not more than four or five, rounded and separated by thick interstices, but becoming angular, with thinner intervening partitions, where more crowded. Surface-striæ fine, irregular, and showing a tendency to converge towards the middle of the base, anastomosing in such a manner as to form a kind of shagreen-like style of ornament."

Obs. This species appears to have been first indicated as a British one by Prof. de Koninck *; and as we have only seen immature and indifferent examples, or what we believe to be such, in Mr. Perceval's cabinet, we have given Messrs. Meek and Worthen's diagnosis in preference to drawing up one of our own, which, at the best, could not but have been imperfect. In placing the *P. cymba* and *P. umbonata* of Von Seebach as synonyms of *P. obtusa*, we are in perfect accord

* Nouvelles Rech. 1e pt. p. 158.

with Prof. de Koninck; but we think that one of these names, *P. cymba*, may with all propriety be retained as a good varietal designation for the young conditions of the species, one state of which, we believe, Von Seebach's figure to represent*, whilst we shall describe a still more juvenile form immediately. Amongst the specimens forwarded to us by Mr. Perceval are three examples, two of which have evidently undergone a good deal of lateral compression; otherwise the form, of one of them at least, we believe, would have approximated to the figure of *P. cymba*, Von Seebach—transversely elongated in relation to the breadth, sharp below, and bearing well-marked terminal cells or cups, as in the figure above quoted. This specimen bears traces of four cups; but the other two individuals, it is quite clear, only had two, and, according to our view, represent the youngest state of the species. One of these little specimens (Pl. XII. fig. 15) has the cuneate form below, the slightly sinuous basal edge, the flattened sides expanding upwards, and the transversely elongated calices seen in some of the figured examples of *P. obtusa*, var. *cymba*. That it would be very unlikely to develop into such a form as *P. cuneiformis* is apparent when compared with the figures we give of the young state of that species (Pl. XII. figs. 11, 12); whilst quite the same remark applies to the young condition of *P. cyclostoma*, with its invariably expanded base of attachment. Assuming, therefore, that our figure and Von Seebach's figs. 4, 4 *a* †, represent various stages in the growth of *P. obtusa*, it is for such forms that we would retain the varietal name *P. cymba*, whilst Meek and Worthen's figures ‡, and Von Seebach's figures of his *P. umbonata* §, will represent the mature colony, so far as it is at present known to us.

Palæacis obtusa may at once be distinguished from the other species of the genus:—from *P. cuneiformis*, H. & Edw., by its wide cuneate form, obtuse basal carina, with the sides at first flattened, then gradually expanding upwards, and the extended upper surface; from *P. cyclostoma*, Phill. (which it much more closely resembles in the number of its cups in the adult state, and the extended upper surface of the colony), by the presence of the obtuse basal carina, more cuneate form, and total absence of the broad base of attachment of Phillips's species.

In the structure of its surface-ornamentation *P. obtusa* approximates to *P. cuneiformis*.

* Zeitschrift, *loc. cit.* f. 4, 4 *a*. † *Loc. cit.*
‡ Illinois Geol. Rep. ii. pl. 17. f. 2, *a–e*.
§ Zeitschrift, *loc. cit.* f. 3, *a–c*.

Loc. and Horizon. Combe Hill, Henbury, near Bristol, in the upper beds of the Lower-Limestone Shales (*S. G. Perceval*); Hook Point, Wexford, in the Mountain Limestone (*De Koninck*).

Other Localities. Nauvoo, Illinois, in the Keokuk division of the Subcarboniferous (*Meek and Worthen*); Dallas city, in Carboniferous Limestone (*Von Seebach*).

Palæacis cyclostoma, Phillips.

Hydnopora? cyclostoma, Phill. Geol. Yorksh. 1836, ii. p. 202, pl. 2. f. 9, 10.

Propora? cyclostoma, Edwards and Haime, Polyp. Foss. Terr. Pal. 1851, p. 225; id. Mon. Brit. Carb. Corals, 1852, p. 152.

Sphenopoterium enorme, Meek and Worthen, Proc. Acad. Nat. Sci. Philad. for October, 1860, p 448; id. Illinois Geol. Surv. Rep. 1866, ii. p. 146, pl 14. f. 1, *a*, *b*.

Sphenopoterium enorme, var. *depressum*, Meek and Worthen, Illinois Geol. Surv. Rep. 1866, ii. p. 146, pl. 14. f. 2, *a*, *b*.

Ptychochartocyathus laxus, Ludwig, Palæontographica, 1866, xiv. pp. 189, 231, pl. 47. f. 14, pl. 69. f. 2, *a*.

Palæacis enormis, Von Seebach, Nachr. k. Gesellsch. Wissensch. zu Gött. for 1866, p. 243; id. Zeitschr. deutsch. geol. Gesellsch. 1866, xviii. p. 309.

Palæacis laxa, Kunth, Zeitschr. deutsch. geol. Gesellsch. 1869, xxi. p. 185, pl. 2. f. 2.

Palæacis compressa, De Koninck, Nouv. Rech. Anim. Foss. Terr. Carb. Belgique, 1872, 1e pt. p. 158, pl. 15. f. 7 (non Meek and Worthen).

Palæacis cyclostoma, De Koninck, Nouv. Rech. Anim. Foss. Terr. Carb. Belgique, 1872, 1e pt. p. 159, pl. 15. f. 8; R. Etheridge, Jun., Mem. Geol. Surv. Scotl. no. 32. p. 97.

Spec. char. Colony simple or composite, subglobose or obtusely subturbinate, usually depressed, composed of a large number of cells (from one to twelve observed), assuming a bi-, trilobate, quadrangular, or multilobate character, usually more or less developed on the same plane, but occasionally becoming superimposed, attached to foreign bodies; and in one well-marked variety they become cuneiform and irregular, or elongate and partly free. Base of attachment large and truncate, flat or variously grooved according to the body to which the colony is fixed, and raised into well-marked, thick, concentric wrinkles or ridges. Cups open, contracting but little, moderately deep, ornamented internally with a large number of small pseudo-ridges, consisting of closely-set microscopic granules or prickles, which in some cases increase towards the margin of the calice by bifurcation; cup-margins circular or oval, with usually well-developed elevated free edges, separated from one another by intervening depressions of variable breadth; cup-floors broad, covered with numerous irregularly disposed prickles similar to those forming the so-called septal ridges. External surface ornamented with finely

vermicular anastomosing ridges, devoid of any defined direction, and equally developed on all parts of the corallum, including the concentrically wrinkled base. Calicular fission well displayed in many instances.

Obs. We have examined upwards of two hundred examples of the species, all in a fine state of preservation, and therefore feel ourselves in a position to pass a few remarks upon it with more than ordinary confidence. First, as to the number of cups. Prof. de Koninck has figured * a single cup of *P. cyclostoma* adhering to a *Zaphrentis*; but, strange to say, out of the large number of specimens we have looked over, we have only found a few examples of this. The simple double cup or cell is, perhaps, with the triple form (Pl. XII. figs. 2, 16), the commonest aspect in which this organism is presented to us. We have also observed numerous individuals in which the cups are four in number (Pl. XII. fig. 1), the condition in which *P. cyclostoma* was figured by Messrs. Meek and Worthen under the name of *Sphenopoterium enorme* †. Five, again, is not an uncommon number amongst the specimens to which we have had access, corresponding with the figure given by Dr. Kunth ‡ as *Palæacis* (*Ptychochartocyathus*) *laxa*, Ludwig. The type example figured by Phillips § possessed six cells, a number to be found on several specimens in the Scotch Survey collection. There are, again, others with seven and nine (Pl. XII. fig. 17), whilst the largest number we have had an opportunity of observing has been twelve; but we see no reason why this number should not be considerably exceeded.

The second point to which we have to draw attention is the varied form of the colony. In the simplest state but one in which *P. cyclostoma* has come under our observation it is bilobed; *i. e.* there are two cells united, as it were, almost base to base, their mouths then looking in contrary directions to one another, and set somewhat obliquely to an imaginary vertical axis. By the addition of another cup a trilobed appearance is assumed (Pl. XII. figs. 2 and 16), whilst a further addition of another gives a more or less quadrangular or sometimes irregular outline to the colony. It not unfrequently happens that after a number of cells have been developed (say six or seven), one, perhaps the first formed, assumes a more or less central position, and is somewhat elevated above the others, and round it the latter appear to radiate, more, perhaps,

* Nouvelles Recherches, pl. 15. f. 8.
† Illinois Report, ii. pl. 14. f. 2 *b*.
‡ Zeitschr. deutsch. geol. Gesellsch. xxi. pl. 2. f. 2 *a*.
§ Geol. Yorksh. ii. pl. 2. f. 9.

from the previously mentioned lobate character than any thing else, but still with a definite, although rough, kind of radiation. The frequent occurrence of this feature will therefore render the figure given* by Herr Ludwig of his *Ptychochartocyathus laxus* not quite so hypothetical as Prof. de Koninck appears to consider†. Another peculiarity which occurs is the piling or growth of the cells one upon another. This is not of very frequent occurrence, and probably took place when the space for the growth of the colony was restricted (Pl. XII. fig. 17). One of the most characteristic points connected with *P. cyclostoma* is the broad base (Pl. XII. fig. 3) and concentric basal swellings, attachment taking place either by a large or small portion of the former. Usually the colony is fixed by the whole area of the base to some foreign body large enough for its entire expansion; but, on the other hand, when adhering to an object of lesser dimensions than itself, a groove or concavity is formed in the base, and the free portion, which would otherwise, as in the first instance, have been also adhering is covered with concentric folds or swellings. We have observed *P. cyclostoma* attached to the following bodies:— Crinoid stems; various species of *Zaphrentis*; *Euomphalus carbonarius*, Sow.; *Bellerophon Urii*, Flem.; *Dentalium ingens*, De Kon.; *Productus longispinus*, Sow.; *Productus punctatus*, Martin; *Chonetes*; and fragments of shelly matter in too unsatisfactory a condition to be determined.

Under certain conditions the colony of *P. cyclostoma* appears to have taken upon itself an irregularity of growth which, had the individuals so distinguished been found by themselves, would have gone a long way towards the establishment of a new species (Pl.XII. figs. 18–20); but between the typical *P. cyclostoma*, with its expanded base and more or less depressed lobate form, on the one hand, and the variety with elongated and laterally spreading corallites on the other, there are so many gradations and intermediate forms, that we cannot see the justice of more than a mere varietal separation. Our eminent friend and colleague, Prof. L. G. de Koninck, has described and figured‡ such a form under the name of *Palæacis compressa*, Meek & Worthen; but with the advantage derived from the examination of a large number of specimens, as previously stated, we feel convinced that the form figured by our friend is identical with the variety of *P. cyclostoma* now under discussion. Certainly we have not had an opportunity of examining the specimen upon which Prof. de

* Palæontographica, xiv. t. 69. figs. 2, 2 *a*.
† Nouvelles Recherches, 1e pt. p. 160.
‡ Ibid. p. 158, pl. 15. f. 7.

Koninck founded his determination, and would therefore speak with all due deference of his opinion; but his figure is very clear and evidently accurately drawn, and on this we decidedly found our opinion that *P. compressa*, De Kon., is not *P.* (*Sphenopoterium*) *compressa*, M. & W.: the former does not possess the characters assigned to the latter by its describers, but does distinctly exhibit those indicative of the form which with us, although at first sight departing from the typical condition of *P. cyclostoma*, is nevertheless insensibly united with it by intermediate forms. We would illustrate our view of this matter as follows:—Starting with the typical form of *P. cyclostoma*, we there see the depressed expanded colony, composed of three or seven cells, as the case may be, the latter more or less all on one plane, and the flattened base. The next step is to an example adhering to a *Dentalium*, where we at once notice a want of the same amount of symmetry possessed by the two former examples, and an extension or lengthening of the cells, giving to the general appearance a certain amount of irregularity, but existing at the same time in conjunction with a similar external ornamentation, basal swellings, arrangement of the striæ, and presence of the granulated floors to the cells. Advancing a step still further, we have presented to us an individual possessing all the characters just described, but with a very much lessened point of attachment—again exemplified in a more forcible manner by the next step in the series, where the cells are longer and more widely separated from one another; whilst in fig. 20 we have two perched upon the summit of a peduncular base of attachment, still showing traces of the concentric ridges; lastly, as the most complete development of the sporting from the original type, we would quote Prof. de Koninck's figure itself, where the irregularity of growth and elongation of the cups is carried to the greatest extent. In concluding this portion of our remarks we would simply state that we regard this irregularity of growth not as of specific value where all the other more important functional characters remain constant, but as simply a varietal character depending upon disadvantageous conditions of growth and habitat—an opinion founded not upon the examination of one or two specimens, but on that of a very large series. We propose to indicate this varietal state under the name of *Palæacis cyclostoma*, Phill., var. *Koninckii*, Eth. & Nich.

The method of reproduction is particularly well exemplified in this species. We give an illustration of the calicular method of gemmation as usually met with (Pl. XII. fig. 16).

Both Professors Morris* and De Koninck† have placed M'Coy's *Astræopora antiqua* as a synonym of this species. As M'Coy's figure presents only a general and not an intimate resemblance to *P. cyclostoma* we refrain from following these authors in this, until we have had an opportunity of examining the original specimen in the "Griffith Collection" in the custody of the Royal Dublin Society. If distinct from *P. cyclostoma*, it will constitute a fourth species; the two, however, are probably identical. *A. antiqua* was found at Hook Point, Ireland. The internal structure of *P. cyclostoma* has already been described.

Localities and Horizon. Cousland and Chalkieside old quarries, near Dalkeith, in shale above the No. 1 limestone; in shale above the limestones displayed at Whitebaulks old quarry, near Linlithgow, Charlestown and Sunnybank quarries, near Inverkeithing, Linn, Duloch, Southfod, Blacklaw, and Cowdens quarries, near Dunfermline, Woodend quarry, near Fordel, Lathalmond quarry, near Roscobie, Gleniston quarry, near Lochgelly: all the foregoing localities, except the first three, are in Fife. East Barns quarry, near Dunbar, Haddingtonshire, and Carlops quarry, at Carlops, Peeblesshire, in shale above the limestones; very common at most of these localities, and, as a rule, in a fine state of preservation; the horizon throughout is that of the Lower Carboniferous Limestone group. *P. cyclostoma* has also been obtained at Carluke, Brockley, and Auchenskeoch, in the west of Scotland, on a similar horizon, and in the Upper Limestone group at Gair, Lanarkshire‡.

Other Localities. Northumberland (*Phillips*), typical locality; Tournai, Belgium (*De Koninck*); Rothmaltersdorf, near Glotz, in Silesia (*Ludwig*), as *Ptychochartocyathus laxus*; Hausdorf (*Kunth*), as *Palæacis laxa*; Rockford in Indiana, Clarksville in Missouri, Saltlick Point in Illinois, in the *Goniatite*-bed of the Kinderhook group of the Subcarboniferous series (*Meek* and *Worthen*), as *Sphenopoterium enorme*, and its var. *depressum*.

4. *Summary of the Species of* Palæacis.

We believe that in all probability it will be possible to reduce the species of *Palæacis* to three only, viz.:—

* Cat. Brit. Foss. 2nd ed. 1854, p. 47.

† Nouv. Recherches, 1e pt. p. 159.

‡ "Cat. Carb. Foss. W. of Scotland," Trans. Geol. Soc. Glasgow, iii. App. p. 16.

1. *P. cuneiformis*, J. Haime.	*Sphenopterium cuneatum*, M. & W.	Compressed, cuneate, longer than wide; base sharp; cells arranged alternately on each lateral edge, and directed obliquely outwards and upwards.
2. *P. obtusa*, M. & W.	= *S. compressum*, M. & W.*; *P. cymba*, v. Seebach; *P. umbonata*, v. Seebach.	Abruptly cuneate below, wider than high; basal edge slightly sinuous in the middle and carina-like, from which the sides expand rapidly upwards, &c.
3. *P. cyclostoma*, Phill.	= *Propora*? *cyclostoma*, Ed. & H.; *Sph. enorme*, M. & W.; *Sph. enorme*, var. *depressum*, M. & W.; *Ptycho. laxus*, Ludw.; *Palæacis enormis*, v. Seeb.; *P. laxa*, Kunth; *P. cyclostoma*, De Kon.; *P. compressa*, De Kon.; *P. cyclostoma*, var. *Koninckii*, E. & N.	Attached to foreign bodies by a broad base, concentrically wrinkled. Colony depressed and lobed, of many cups, or elongated and laterally prolonged. Cups with a number of microscopical granules arranged in vertical rows; floors of the cups ornamented with granules.

EXPLANATION OF PLATE XII.

Fig. 1. A small specimen of *Palæacis cyclostoma* attached to the stem of a Crinoid, of the natural size.

Fig. 2. Another specimen of the same, viewed from above, of the natural size.

Fig. 3. Under surface of a large specimen of the same, in which the peduncle of attachment has been a narrow one, of the natural size.

Fig. 4. Portion of the surface between two of the cups in a specimen devoid of large pores, magnified.

Fig. 5. Portion of the surface between two of the cups in a specimen in which arge pores are present, magnified.

Fig. 6. Portion of the under surface, showing pores and elongated apertures, magnified.

Fig. 7. Thin section of a colony of *P. cyclostoma*, attached to the shell of a Gasteropod, and enlarged eight diameters, showing the dark matrix filling the cups (*a*), the trabecular tissue (*c*), and the compact tubulated tissue (*b*) which forms the floors of the cups.

Fig. 8. A portion of the same, enlarged twenty-five diameters, showing the matrix filling the cup (*a*), the compact tubulated tissue in the floor of the cup (*b*), and the denser but still tubulated tissue bounding the lacunæ of the deeper vesicular tissue (*c*).

Fig. 9. A specimen of *P. cuneiformis*, viewed from the front, of the natural size.

Fig. 10. The same viewed sideways, showing the cups.

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* Meek and Worthen appear to have thought it very probable that this might be only a variety of their *S. obtusum*.

Figs. 11 & 12. Different views of a small specimen of the same, in which only two cups are present, of the natural size.
Fig. 13. Portion of the surface of *P. cuneiformis*, enlarged.
Fig. 14. A portion of a thin section of *P. cuneiformis*, magnified, showing lacunæ and tubuli.
Fig. 15. Two views of *P. obtusa*, showing the arrangement of the cups; Combe Hill, near Bristol (S. G. Perceval).
Fig. 16. A specimen of *P. cyclostoma*, viewed from above, showing the mode of fission in one of the cups. Fife.
Fig. 17. Another variety of the same, viewed from above, showing the piling of the cups one upon another. Fife.
Fig. 18. A variety of the same, attached to a Crinoid stem, in which the cells are assuming a more irregular form. Fife.
Fig. 19. Another condition of *P. cyclostoma* (var. *Koninckii*, nobis), in which the cells are still more elongated and partially free.
Fig. 20. An extreme variety of the same (*P. cyclostoma*, var. *Koninckii*, nobis), in which the colony consists of two cells or cups mounted upon a peduncular extension of the base of the colony.

XXVII.—*Descriptions of new Species of Lepidoptera collected by the late Dr. F. Stoliczka during the Indian-Government Mission to Yarkund in* 1873. By F. Moore, F.Z.S.

Satyrinæ.

Hipparchia lehana.

Allied to *H. baldiva* from Upper Kunawur. Upperside paler in colour, the discal transverse luteous band is broader on both wings, and its inner border in the male is inwardly oblique. Both sexes above and beneath are without the small ocellus on the band above the anal angle. The underside is also very much paler, and the transverse sinuous lines wider apart.

Exp. ♂ 2, ♀ 2¼ inches.

Hab. Leh, Kharbu (13,000 feet), Ladak.

Nymphalinæ.

Vanessa ladakensis.

Most nearly allied to *V. rizana* from Cheeni. Differing in being somewhat smaller, less angled below the apex of fore wing and at the middle of the hind wing; the black markings on the upperside are much less prominent, the black oblique bands on the fore wing merging into the red, and appearing somewhat confluent; the outer transverse discal yellow band is also broader. Other markings similar. On the underside

the interspaces between the markings on the fore wing are very much paler.

Exp. $1\frac{5}{8}$ inch.

Hab. Gogra, Changchenmo (15,000 feet), Ladak; Karatagh lake, on snow (16,890 ft.), Yarkund.

Pierinæ.

Baltia, n. g.

Fore wing very short, costa considerably arched from the base, apex and posterior angle rounded, exterior margin oblique; costal vein short; subcostal vein arched to end of the cell, five-branched, first and second branches arising at equal distance apart before the end of the cell and terminating on the costa before the apex; third branch bent near its base but beyond the discocellulars, at its middle, and immediately before its termination before the apex; the fourth and fifth branches, and the radial branch starting respectively below from each of these angles, the fourth branch being very short, and in the female the radial starts from end of the cell; cell broad; discocellulars of nearly equal length, oblique, slightly bent inward; median vein three-branched, at equal distances; submedian curved: hind wing long, somewhat oval, slightly broader than fore wing; apex and exterior margin very convex, abdominal margin long; costal vein short; subcostal three-branched; cell broad; discocellulars oblique, upper shortest; median three-branched; submedian nearly straight. Body small; abdomen short; thorax and front of head clothed with long lax hairs. Palpi very long, slender, densely hairy beneath. Legs short, femora fringed beneath with long lax hairs; antennæ short, club large and spatulate.

Allied to *Mesapia* (*M. peloria*, Hewits. Exot. Butt. i. *Pieridæ*, pl. 2. f. 15).

Baltia Shawii.

Mesapia Shawii, Bates, in Henderson's 'Lahore to Yarkund,' p. 305 (1873), ♀.

Male. Upperside white; base of both wings densely black-speckled; fore wing with the costal edge ochreous and slightly black-speckled; a large black triangular oblique spot at end of the cell; a short transverse subapical black band, and a marginal row of black decreasing triangular spots: hind wing sparsely and minutely speckled with dark grey, the speckles dense across the disk, and there forming a curved sinuous indistinct band, a slight black streak at end of the cell. Body black. Palpi ochreous above, fringed with black beneath.

Antennæ black, stem white-ringed. Abdomen beneath yellow. Legs black above, white beneath. Underside—fore wing with markings as above; costa and exterior margin tinged with ochreous: hind wing black-speckled, densely at base, and also forming a narrow curved discal sinuous band; a slight black streak at end of the cell.

Female differs in having the markings above less black, the subapical band on the fore wing being continued across the wing on both upper and underside.

Exp. $1\frac{5}{10}$ inch.

Hab. Aktagh (15,590 feet), Yarkund (*Stoliczka*); Chang-Lung Pass, 18,000 feet (*Shaw*).

Colias Stoliczkana.

Male. Upperside pale chrome-yellow, base of costal and abdominal borders greenish yellow; base of wings speckled with blackish brown; both wings with a broad yellowish-brown marginal band; a slight narrow dusky lunular streak at end of the cell in the fore wing. Underside—fore wing pale yellow, costal border and exterior margin greenish yellow; a dusky black-speckled lunular spot at end of the cell, and a discal row of indistinct speckled spots: hind wing greenish yellow, with darker green speckles; an ochreous-brown patch at end of the cell enclosing a white irregular mark and dot; a discal series of dusky-brown dentate spots. Antennæ and legs reddish.

Exp. $1\frac{1}{2}$ inch.

Hab. North of Changla (17,000 feet), Ladak.

Nearest to *C. eogene*, Felder, Nov. Reise, Lep. pl. 27. f. 7. Differs in being smaller, and having the median portion and cilia pale chrome-yellow (instead of orange), the discocellular mark of fore wing less prominent and lunular (instead of oval); the broad marginal band is yellow-brown (instead of dark brown), the costa and head being also of the same yellow as the other part. On the underside the discocellular mark is also lunular and not pale-centred.

Lycæninæ.

Polyommatus yarkundensis.

Allied to *P. icarus.*

Upperside dark blue, anterior and exterior borders dusky brown; fore wing with an indistinct streak at end of the cell; hind wing with a marginal row of rather indistinct ochreous-bordered black spots. Cilia cinereous white. Underside ochreous grey: fore wing with a white-centred black spot in

middle of the cell, another below it, one at end of the cell, and a curved discal series of seven spots; a marginal row of indistinct spots bordered above by a dentate line with pale ochreous interspaces: hind wing with three white-circled black subbasal spots and a curved discal series of seven spots; a marginal row of prominent spots bordered above by dentate line with ochreous interspaces.

Exp. 1$\frac{1}{4}$ inch.

Hab. Yarkund (3923 feet).

Polyommatus kashgharensis.

Allied to *P. semiargus.*

Male. Upperside pale blue, with narrow black exterior marginal line; costal edge white; cilia white, with dark inner border. Underside slightly pearly grey; base of the wings pale metallic green: fore wing with a whitish-bordered black spot in middle of the cell, and a curved discal series of five spots; a very indistinct spot at end of the cell, and a less distinct marginal series of spots: hind wing with three subbasal and a curved discal series of six small white-circled black spots, an indistinct spot at end of the cell, and a marginal row of spots with slightly ochreous upper dentate line.

Exp. 1$\frac{1}{4}$ inch.

Hab. Yangihissar (4320 feet), Yarkund.

Polyommatus lehanus.

Allied to *P. pheretes.*

Male. Upperside violet-blue, somewhat brownish blue at the margins; cilia white. Underside leaden grey, palest at the apex and on hind wing; fore wing with a white-bordered black spot at end of the cell, and a transverse discal oblique series of five spots: hind wing with a large triangular greyish-white spot at end of the cell, and a series of eight small round spots recurving from near base of costa across the disk to anal angle.

Exp. $\frac{9}{10}$ inch.

Hab. Leh (11,538 feet), Ladak.

Bombycidæ.

Arctia orientalis.

Similar to *A. caja*, differing above on the fore wing in the general form of the bands, these being entire and transversely continuous (not broken longitudinally as in *caja*); on the hind wing the spot at the end of the cell is absent; this wing also has a yellowish-white narrow marginal line above, and brown

cilia both above and beneath; the dorsal black band is present on each segment, and longer.

Exp. $2\frac{1}{4}$ inches.

Hab. Sonamurg, Cashmere (*Stoliczka*).

Euproctis kargalika.

Male and *female.* Fore wing creamy white, veins greyish white; a large brown-speckled ochreous discocellular spot and a row of submarginal spots: hind wing white. Thorax creamy white; abdomen of male golden yellow, of female grey with slight black rings and large glossy golden-yellow tuft. Shaft of antennæ white, pectinations brown. Underside glossy white; costa of fore wing in male broadly suffused with brown.

Exp. ♂ $1\frac{5}{10}$, ♀ $1\frac{6}{10}$ inch.

Hab. Kargalik (4440 feet), Yarkund.

Euproctis lactea.

Uniform cream-white, without markings. Abdominal tuft pale yellow. Underside paler cream-white, costal border of fore wing ochreous brown. Palpi ochreous brown. Antennæ pale ochreous brown, shaft white. Fore tibiæ with ochreous-brown tuft.

Exp. $1\frac{3}{8}$ inch.

Hab. Kargalik (4440 feet), Yarkund.

Oxicesta marmorea.

Male. Upperside greyish brown: fore wing with a pale yellowish irregular streak along middle of the cell to costa near the apex, a small spot beyond the cell, and an indistinct pale streak below the cell; apical margin of costa and outer margin pale testaceous, alternated with a short black streak which extends through the cilia: hind wing uniform pale greyish brown, slightly yellowish at the base. Body and legs greyish brown. Antennæ brown. Underside uniform greyish brown. Cilia of fore wing with black streak.

Exp. $1\frac{1}{10}$ inch.

Hab. Sasstekke, Yarkund.

Differs from *O. geographica* in being longer in the wings, of different colour, and without the two transverse zigzag white bands on the fore wing.

Ptilophora kashghara.

Male. Pale grey; fore wing irrorated with brown scales, crossed by three indistinctly defined narrow zigzag brown

bands, which are slightly dentate on the veins; cilia alternate pale grey and brown: hind wing pale grey, sparsely sprinkled with brown scales. Thorax greyish brown. Abdomen brown, three anterior segments with dorsal row of black tubercular scales, tip also black. Antennæ yellowish testaceous. Underside grey, sparsely brown-speckled, long pubescence of abdominal border brown and black. Legs pale brown.

Exp. $1\frac{5}{10}$ inch.

Hab. Yangihissar (4320 feet), Kashghar.

Noctuidæ.

Acronycta kargalika.

Female. Fore wing pale silvery brownish grey; reniform and orbicular marks whitish, contiguous, brown-bordered; a longitudinal streak from the base, a contiguous subbasal transverse recurved line, a discal transverse lunular line crossed near posterior angle by a short streak; some short costal marks and a streak on cilia between each vein brown: hind wing glossy greyish white, outer borders and veins pale greyish brown. Thorax and abdomen dark grey. Antennæ grey. Underside greyish white: fore wing with greyish-brown costal streaks and hind margin; hind wing with brown basal costal streak and discocellular spot. Palpi brown at sides. Legs grey, femora tipped with black; tibiæ longitudinally streaked and tarsi banded with black.

Exp. $1\frac{5}{10}$ inch.

Hab. Kargalik (4440 feet), Yarkund.

Most nearly allied to *A. tridens*, but differs in being darker; the markings are somewhat similar; but the basal longitudinal streak is shorter, thus giving a wider interspace between the two transverse lines.

Hydræcia tibetana.

Male. Pale reddish testaceous; fore wing crossed by two pale brown narrow lines with pale inner border, the first line subbasal and outwardly oblique, the other discal; a submarginal row of blackish dots, and pale marginal line; orbicular and reniform spots indistinct, but defined by a brownish border: hind wing and abdomen paler. Underside palest on the middle of the wings; discal line on both wings, and a discocellular spot slightly perceptible on the hind wing. Antennæ, palpi, and fore legs reddish testaceous.

Exp. $1\frac{5}{10}$ inch.

Hab. Leh, Ladak.

Mamestra canescens.

Male. Fore wing brownish grey; orbicular and reniform marks greyish white, with narrow black border; a short double black streak below the base of the cell, and a quadrate mark below the orbicular spot; an indistinct pale submarginal irregular fascia, and black marginal lunular line with whitish inner border: hind wing pale greyish brown. Thorax and abdomen greyish brown; antennæ brown. Underside glossy pale greyish brown, both wings with indistinct short transverse discocellular streak.

Exp. $1\frac{5}{8}$ inch.

Hab. Kargalik (4440 feet), Yarkund.

Agrotis tibetana.

Upperside—fore wing greyish brown, with indistinct dusky transverse subbasal double sinuous line, discal dentate lines, and pale outer-bordered, wavy, narrow, submarginal band; speckled orbicular and quadrate reniform mark; cilia with narrow white marginal line: hind wing brownish white; veins and outer margin brown; cilia white. Antennæ and body greyish brown, tip of abdomen yellowish. Underside—fore wing greyish white, dusky brown basally along the costa and hind margin, and speckled on outer margin: hind wing whitish; an indistinct dusky spot at end of the cell, a spot mesially on each vein, and narrow lunular marginal line. Legs greyish brown, femora and tibiæ streaked and tarsi banded with black.

Allied to *A. ripæ.*

Exp. $1\frac{3}{8}$ inch.

Hab. Leh, Ladak.

Spælotis undulans.

Male and *female.* Fore wing grey-brown, irrorated with darker scales; crossed with subbasal, antemedian and postmedian double pale-bordered lunular brown bands, each ending on the costa in a darker spot; a submarginal pale outer-bordered brown wavy fascia, and small black marginal lunules: hind wing glossy greyish white, with brownish tinged borders, brown veins, and marginal lunular line. Antennæ and palpi greyish brown. Underside glossy greyish white; tibiæ streaked and tarsi banded with black.

Allied to *S. pyrophila.*

Exp. $1\frac{8}{10}$ inch.

Hab. Ak Masjid, S.E. of Chiklik, Yarkund.

Tæniocampa chiklika.

Male. Upperside grey: fore wing densely brown-speckled; cilia with a brown-speckled line; orbicular and reniform spots pale; an indistinct transverse subbasal and discal sinuous pale-bordered line: hind wing minutely brown-speckled, and with a pale brown cilial line. Underside paler, both wings uniformly speckled, and with a very indistinct sinuous discal band. Antennæ blackish, shaft grey. Body, palpi, and legs brown-speckled.

Exp. $1\frac{5}{8}$ inch.

Hab. S.E. of Chiklik, Yarkund.

Hadena Stoliczkana.

Male. Fore wing pale greyish brown, crossed by three indistinct, narrow, brownish, zigzag double lines; orbicular spot pale; reniform mark very indistinct; two black spots linearly disposed below the apex; a double, narrow, marginal, blackish lunular line; some short streaks on the costa: hind wing with the veins and a broad marginal band fuliginous brown. Cilia white. Body pale greyish brown. Antennæ brown. Underside greyish white; both wings crossed by a distinct brown curved discal band; fore wing with a discocellular brown lunule, and hind wing with a spot; a marginal lunular dotted line. Legs grey-brown, banded with black.

Exp. $1\frac{4}{8}$ inch.

Hab. Kufelang (14,810 feet), Yarkund.

Heliothis hyblæoïdes.

Upperside—fore wing grey, minutely brown-speckled; a slightly apparent brown streak at end of the cell, and a pale submarginal zigzag line: hind wing brownish white, with a broad greyish-black median transverse band, which is confluent with a curved discocellular black streak; a large oval black spot on middle of outer margin, abdominal border fringed with brown. Cilia white. Body grey, whitish beneath. Legs greyish white and brown-speckled. Underside greyish white: fore wing with a dusky black, broad, transverse apical band, and an outwardly oblique median band: hind wing with a dusky black dentate streak at end of the cell; a slight median band and oval marginal spot.

Exp. $1\frac{3}{8}$ inch.

Hab. Chiklik (14,480 feet), Yarkund.

Pyralidæ.

Pyrausta cuprealis.

Upperside dark cupreous brown: hind wing with a broad median discal yellow band. Underside paler, basal two thirds of both wings yellow, with brown-speckled subbasal patch. Antennæ black. Body beneath cupreous black, speckled with yellow. Palpi yellow beneath. Legs yellow, with cupreous speckles.

Exp. $\frac{6}{8}$ inch.

Hab. Gaganghir (near Sonamurg), Cashmere.

Eudorea granitalis.

Upperside—fore wing pale brown, crossed by several irregular wavy grey-bordered black lines; cilia grey alternated with black: hind wing greyish white, traversed by numerous short, brown striæ, somewhat regularly disposed between the veins, the wing being suffused with brown along external margin. Cilia grey, with dusky line. Body grey, speckled with brown. Palpi brown at apex, greyish at base. Legs grey, speckled with black. Underside as above, markings paler.

Exp. $\frac{8}{10}$ inch.

Hab. S.E. of Chiklik, Yarkund.

Eudorea transversalis.

Male. Upperside—fore wing grey, speckled with brown; crossed by an oblique subbasal and a recurved discal black-speckled band; exterior margin black-spotted; some black speckles at end of the cell: hind wing pale brown, with darker marginal border. Cilia grey, with brown border. Body grey-brown and black-speckled. Palpi speckled with black and white above. Antennæ dark brown. Underside pale ochreous grey. Legs speckled grey and black, fore and middle legs with grey bands.

Female paler, the bands across fore wing somewhat broader, those on the hind wing more distinct.

Exp. $\frac{8}{10}$ inch.

Hab. Ighizyar (5600 feet), Yangihissar (4320 feet), Yarkund.

Geometridæ.

Gnophos Stoliczkaria.

Upperside pale ochreous grey, minutely brown-speckled, forming more or less numerous short transverse striæ; both wings with an indistinct oval spot at end of the cell; fore wing with a subbasal and discal, and hind wing with a discal series

of dentate points, and marginal lunular dotted line. Cilia white. Underside paler; speckles sparsely apparent; cell-spot less distinct.

Exp. 1⅜ inch.

Hab. Ak Masjid (8870 feet), Yarkund.

Thera kashghara.

Upperside pale brownish cinereous: fore wing crossed by three equidistant pale-bordered blackish lines, the basal nearly straight, the second slightly waved, the outer irregularly undulated, each darkest at the costal end; the interspaces between the two outer lines darker cinereous brown; a slight short sinuous spot at apex, an indistinct paler transverse undulating line on outer margin, and a distinct darker narrow marginal line. Underside paler, transverse lines very indistinctly visible. Legs dusky above. Antennæ brownish.

Exp. 1⅜ inch.

Hab. Chiklik (14,480 feet), Yarkund.

Crambidæ.

Homœosoma venosella.

Upperside—fore wing pale greyish ochreous, minutely brown-speckled, sparsely disposed along the veins, and having a transverse pale discal indented line and an indistinct space at end of the cell; hind wing cinereous white, with pale brown marginal line. Cilia white. Body and palpi above greyish ochreous, paler beneath. Underside whitish cinereous.

Exp. ⅞ inch.

Hab. Ak Masjid (8870 feet), Yarkund.

Myelois griseella.

Upperside cinereous grey; fore wing densely irrorated with brown, crossed by two median, undulating, very indistinct speckled lines; an indistinct streak at end of the cell; both wings with an outer marginal narrow lunular brown line: hind wing whitish, with a very pale cinereous-brown marginal and an indistinct narrow submarginal band. Cilia whitish, with a narrow darker marginal line. Underside paler cinereous. Head and thorax brownish. Abdomen cinereous brown.

Exp. 1⅛ inch.

Hab. S.E. of Chiklik, Yarkund.

Myelois undulosella.

Male and *female.* Upperside ochreous grey; fore wing

speckled with brown, crossed by two pale-bordered, median, oblique, undulating, blackish lines, both of which are sinuous at the costal end, and enclosing a dark pale-centred streak at end of the cell; middle of hind margin and the outer border grey, the latter with an indistinct pale sinuous line slightly black-speckled; cilia whitish, alternated with two dark marginal lines: hind wing pale brownish cinereous externally; cilia white, alternated with one dark marginal line, and a dark patch at the middle. Body ochreous grey. Underside pale cinereous.

Exp. $1\frac{2}{5}$ inch.

Hab. Ak Masjid (8870 feet), Ak Talla (7342 feet), Yarkund.

Tortricidæ.

Conchylis Stoliczkana.

Upperside—fore wing white, with three transverse, outwardly oblique, ochreous-brown bands, two inwardly oblique discal bands, and a spot at end of the cell; a brown-speckled marginal band: hind wing cinereous white, with narrow brown marginal band. Body white, speckled with black, and with white segmental bands. Legs white. Palpi white, speckled with brown. Underside cinereous white; outer bands on fore wing indistinctly visible.

Exp. $\frac{6}{8}$ inch.

Hab. S.E. of Chiklik, Yarkund.

Tineidæ.

Depressaria stigmella.

Fore wing pale brownish ochreous, greyish along the apical portion of the costa, interspersed with a few dusky speckles; a dusky grey short straight streak at end of the cell; a few speckles on outer margin: hind wing pale ochreous white. Underside paler. Legs pale ochreous.

Exp. $\frac{9}{10}$ inch.

Hab. Yangihissar (4320 feet), Kashgar.

Nearest allied to the European *D. subpropinquella.*

XXVIII.—*Description of a new Species of Land-Planarian from the Hothouses at Kew Gardens.* By H. N. Moseley, F.R.S.

From time to time interesting worms and other invertebrates are found living in the various hothouses at Kew Gardens.

These are, by the direction of Sir Joseph Hooker, carefully preserved, and are sent to various naturalists for examination. The gardeners take an interest in the matter, and take care to bring the specimens in good condition to Mr. Thiselton Dyer.

I received a short time since from Mr. Dyer a specimen of a living Land-Planarian of the genus *Bipalium*, which was thus found in one of the hothouses at Kew. A similar worm was discovered in the same house a year or two ago, and one also on a former occasion, and it seems probable that the species is established and breeds in the house.

The present specimen when it reached me was in a dying condition, having evidently suffered from exposure to cold. A sketch of it, however, was made by Mr. Ray Lankester (who received it from Mr. Dyer) whilst it was in a healthy and lively condition; and assisted by this sketch I give here a description of the species, which appears to be new. It is remarkable in the genus for its great length, which surpasses, so far as I know, that of all other species of *Bipalium*. Unfortunately it is quite uncertain from what region it may have come, since the house in which it was found contains plants from various parts of the world. It will be remembered that Mecznikow's *Rhynchodemus* (*Geodesmus*) *bilineatus*, the anatomy of which was described by that author in the Bull. Acad. St. Petersburg, 1865, vol. ix. p. 433, was found in a hothouse in the Botanic Gardens of Giessen, and was probably introduced, like the present species, with foreign plants. It has not been met with since. I have given an account of the structure of Land-Planarians of the genera *Bipalium* and *Rhynchodemus* in a paper "On the Anatomy and Histology of the Land-Planarians of Ceylon," published in the Phil. Trans. for 1874, p. 105, and some details of the structure of members of other genera of the family Geoplanidæ, and a list of all the known species of Land-Planarians, in a further paper, "On the Structure of several Forms of Land-Planarians, &c.," published in the Quart. Journ. Microsc. Sci. vol. xvii. new ser. 1877, p. 273.

Bipalium kewense, sp. n.

Body slightly rounded above, flat beneath, slightly narrower just behind the head, tapering very gradually posteriorly to terminate in a long and slender hinder extremity; with a narrow but well-marked ambulacral line. Lunate head of moderate size, about twice as broad as the part of the body immediately behind it.

General colour of the body light ochre-yellow above;

beneath very pale, almost white. Five dark violet stripes, a mesial and two pairs of lateral, extending along the entire length of the dorsal surface. The mesial stripe narrow and linear, the succeeding pair broad and band-like, and the outermost pair again linear. The outermost pair placed at a short distance from the lateral margin of the upper surface, and the band-like pair at half the distance between these and the central stripe. Just behind the head the two lateral bands on either side fuse together, and form a pair of broad dark patches.

Faint and narrow violet stripes mark the margin of the ambulacral line on the under surface of the body.

Length of the single specimen 9 inches; extreme breadth of the body $\frac{1}{7}$ inch, of the head $\frac{1}{5}$ inch.

Exeter College, Oxford,
Feb. 18, 1878.

XXIX.—*Studies on the Hydroida.* By C. Mereschkowsky.

[Plates XIII., XIV. & XV.]

I. *Morphological Considerations.*

The human mind has not the power of retaining in its memory the representations of all the concrete objects which are presented to its five senses; for the number of these objects and of facts is too immense for its faculties, which are still so imperfectly developed. But, at the same time, the mind desires to be in possession of as many facts as possible; hence the tendency to generalization and the double character of every science: on the one hand, we have concrete facts without any bond between them, without any idea, serving only as raw material; on the other, generalizations, more or less abstract ideas. Not only every science, but even every branch of each science, every group of events or facts, may therefore have its philosophy—that is to say, its generalizations, its ideas, its laws which govern the facts.

The usefulness of these laws or generalizations, even in the case of small groups of events, cannot be doubted; in reality it is often only by taking advantage of them that a thinker can arrive at generalizations of a higher degree, without the necessity of busying himself in the midst of thousands of little facts and minute details.

In the following pages I shall speak of a group of facts which may be observed among the Hydromedusæ,

and which may be generalized into a single idea, a single *law of metamerism* (*Metamerengesetz*) or of *articulation*. This law may be formulated as follows:—*The Hydroid may be composed of two or several metameres, similar or not; each metamere in its turn is composed of several antimeres.*

Fig. 1 shows diagrammatically a Hydroid belonging to what I call the *articulate type*; it will be seen that it consists of three very distinct metameres, each of which is in its turn composed of four antimeres*.

This law governs a considerable number of forms among the Hydromedusæ; we may recognize it in the species belonging to various genera—for example, in *Stauridium*, *Coryne*,

Fig. 1.

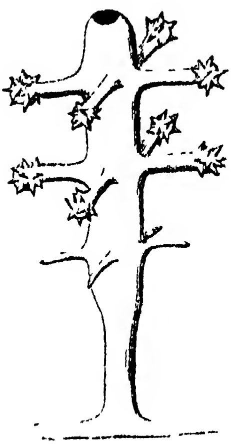
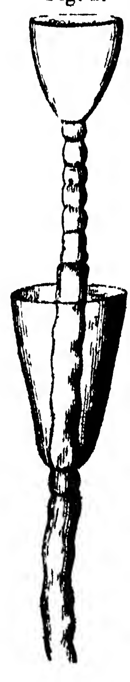


Fig. 2.



Syncoryne, *Millepora*, *Cladonema*, *Tubularia*, *Cordylophora*, *Gemmaria*, &c.; but all the cases in which we remark the articulate type among the Hydromedusæ belong exclusively to the order of naked Hydroids (Athecata). There is not a single Hydroid belonging to the order Thecaphora which

* According to M. E. Häckel we should have to call such a type "*forma staurastoma diplopola articulata*."

has the least normal tendency to the production of metameres*.

The number of metameres is very variable in different genera and species. We know several Hydroids (as, for example, *Cladonema radiatum*) which have only two metameres, usually, in this case, very distinct and well marked. Up to the present time we do not know a single Hydroid which has three distinct metameres; but we know one with four very clearly developed; this is *Stauridium productum*, which I have found in the White Sea. After it come the forms which have more than four metameres; but in these cases they are not very distinct, and their number is no longer constant, but varies with the age and development of the individual. At the same time, this variation in the number of metameres takes place within certain limits; for there are species in which the metameres never attain the great number met with in other species.

Among the forms which are very rich in metameres I can cite several, but especially *Coryne pusilla* and *Gemmaria implexa*, in which we may see a very great quantity of metameres. It is true that in such cases it is impossible to fix clearly the boundaries of two metameres, and that it is often impossible to decide whether two tentacles belong to one or to two different metameres; but nevertheless it is easy to see that we have to do with the same articulate type as in *Stauridium* and *Cladonema*; only here the order of arrangement of the tentacles, in consequence of their great number, has become very much effaced.

As to the nature (*das Wesen*) of the *law of metamerism*, the cause which has produced the articulate type among the Hydroids, I think I am justified in explaining it in the following manner:—The Hydroid, in consequence of a great abundance of nourishment, or from some other cause unknown, began to grow in the direction of the primary axis of its body. Growth, as we know, does not differ generically from the process of multiplication; the latter is only a particular case of the former; and the two processes depend greatly upon each other.

The growth of the Hydroid beyond its specific limit causes

* A single anomalous fact is known to me in the Thecaphora, in which there appears a tendency, although a very feeble one, to take on the articulate form. This is the *Clytia poterium*, Agassiz (fig. 2), in which one hydrotheca is placed above another, which has produced it, no doubt, by division. But this case can only be regarded as an anomaly, the normal individuals never having any trace of metamerism. This anomaly has been described by Agassiz, 'Contributions to the Natural History of the United States,' iv. p. 303, pl. xxix. fig. 1.

multiplication by means of incomplete transverse division (*unvollständige Quertheilung*)—that is to say, the appearance of one or several new systems of secondary axes, which are all, at first, in accordance with the law of heredity, equal among themselves and to the first axial system from which they have proceeded. But instead of separating from each other and entering upon a free and independent life, as we see in a very analogous process of gemmation in the *Scyphistoma* of the Discophorous Medusæ (fig. 3)*, each system of secondary axes remains connected with a small community and leads a social life (fig. 4).

In order to demonstrate that this view is correct, and that the articulate type is nothing more than the product of an incomplete transverse division, we may consider the singular anomaly presented by *Clytia poterium*, Ag. (fig. 2). There is no doubt that this form is produced by increase of growth, which for its part produces a transverse division analogous to that which takes place in the *Scyphistoma*, but with the difference that here the superior articulation does not separate from the colony, because the division is incomplete. But if we imagine the Hydroid deprived of its calycle we shall have fundamentally the same picture that is presented by the digrammatic figure of an articulate Hydroid in fig. 1.

Let us now consider fig. 5, which represents, after Mr. Hincks†, the interesting Hydroid *Vorticlava proteus*. Owing to its great contractility it can take on different forms; and one of them (fig. 5), in which the superior metamere is removed to a great distance from the inferior metamere, and in which the two articulations are united only by a long and very thin peduncle, proves very clearly that the metameres are true articulations produced by incomplete division. Just the same thing (that is to say, the great individuality of each metamere, united only by a fine peduncle) occurs also in *Corymorpha pendula*, Agass.‡; only the individuality of the metameres is unequal, being easy to see in some Hydroids (such as *Vorticlava*, *Stauridium*, and *Cladonema*), and more or less effaced in others with many metameres (*Zanclea*, *Coryne*, &c.). But in any case we must regard the articulate type as a small colony.

The number of individuals in such a community may be

* Each tentacle (each antimere), or rather each pair of antimeres, is nothing but an axis vertical to the axis of the body (principal or primary axis), which is ordinarily called a secondary axis. The different types of Hydroids have 1, 2, 3, 4 n, ... secondary axes, *i. e.* 2, 2×2, 2×3, 2×4, $2\times n$ tentacles.

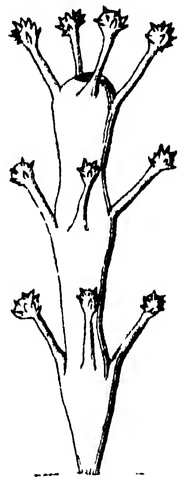
† Mon. Brit. Hydr. vol. ii. pl. xxiii. fig. 2, *d*.

‡ Contrib. Nat. Hist. Un. States, vol. iv. pl. xxvi. figs. 14 and 17.

considerable, as we have already seen, about ten or even more; and, in fact, it is most usual for their number to exceed four or five.

Fig. 3.

Fig. 4.



In these cases, and especially where we have to do with about ten metameres, the explanation of the origin of these articulated forms which I have just given cannot suffice; and hence it must be supplemented by a very interesting law, which Prof. N. Wagner of St. Petersburg has denominated the *law of physiological inertia*, and has so happily applied to the explanation of the incredible number of metameres (articulations) with which various worms (Annelida) are furnished.

Fig. 5.

According to this law, some cause having originated two or three metameres, the appearance of the following metameres may be brought about without the further aid of the primary cause, but solely under the influence of a tendency that the organism has to repeat the process of the appearance of metameres (a process at first induced by some external influence [*choque*], such as abundance of food) by *inertia*, as it were, until finally resistance, under different forms, may put a stop to it.

The different qualities and properties of an organism are often retained, by force of heredity, without interruption and without modification during a long series of generations, even when the cause which has induced these qualities has long disappeared. It is so in the case in question: a certain

cause has induced in the organism the tendency to grow constantly in length by incomplete transverse division; and if it happens that this cause acts for a long time, through a long series of generations, it is easy to understand that this tendency may acquire so great a persistency, and may become so powerful, that it will continue to manifest itself even after the disappearance of the original cause. Considered from this point of view, the *law of physiological inertia* appears simply to be a particular case of another more general law—the law of heredity; and I believe that if we apply this law (without which the phenomena of the Annelida are perfectly obscure and incapable of explanation) to the group of Hydroids, and especially to the articulate type, we shall attain the possibility of explaining and understanding the appearance of such forms as *Coryne pusilla* and *Gemmaria implexa.*

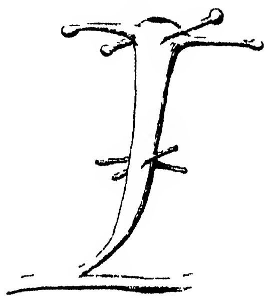
In the articulate type there is a peculiarity which is very interesting, especially because it can be very clearly explained, and to which I wish to call attention, namely the form of the tentacles. One of the most characteristic features which always accompany the law of metamerism in the Hydroids, is the capitate form of the tentacles, which in this case, are always very short (figs. 1, 4). This peculiarity of the articulate forms is especially observable in the species with numerous metameres, in which the tentacles are excessively short. There are very few exceptions to the rule that articulation is combined with the capitate form of tentacles; and nearly all these exceptions can be perfectly well explained.

In seeking to explain this fact, and to find the cause of its occurrence (*raison d'être*), we must first of all call attention to the coexistence of the two facts, articulation and capitate tentacles, and inquire whether this singular and invariable coexistence is not due to a causal relation between the two facts. It is more than probable that this is the case; and, as we shall see immediately, it is the articulation that is the cause of the form of the tentacles.

The articulate type has no doubt originated from the non-articulate type with 4, or, in general, $2 \times n$ filiform tentacles. The tentacles of this general type ($2 \times n$) are:—1, usually rather long and slender, not capitate, endowed with great contractility; and, 2, covered over all their surface with a quantity of thread-cells. Such an organization is adapted to subserve two functions at once—namely, (1) seizure of food, and (2) defence against enemies by means of the venomous thread-cells. When the Hydroids furnished with metameres began to be developed from this type thus constructed and non-articulate, and, at the same time, the length of the

whole animal increased considerably, so that the long, slender, original tentacles, which previously extended beyond the apex of the body (where the mouth is placed), became relatively shorter, they would no longer reach the buccal orifice, which would deprive them of all power of acting as organs of nutrition. This must certainly take place, especially with the lowest tentacles. The part which they performed being thus diminished, and their significance in the economy of the animal changed, the tentacles would no doubt undergo, if not complete atrophy, at least a considerable diminution in their development. This is, in fact, what we observe. In such articulate forms as *Cladonema radiatum* (fig. 6), for example, which is furnished with two very distinct metameres, we remark that the four lower tentacles, belonging to the inferior metamere, are too short to reach the mouth, and consequently cannot possibly assist in the process of nutrition; at the same time they are much less developed, much shorter and more delicate than the other four tentacles belonging to the upper metamere, which can very easily reach the mouth.

Fig. 6.



The form with four metameres (*Stauridium productum*) shows us the same thing. In this also the four tentacles of the inferior metamere are, to a very great degree, atrophied*. The same thing takes place in all the other articulate forms, even when the number of metameres is very considerable, as, for example, in *Coryne pusilla* and *Gemmaria implexa.* In all cases the inferior tentacles are less developed, half or one third of the length of those of the superior metameres, and the more they approach towards the basal extremity of the body the shorter they are, so that in the lowest regions the length of the tentacle often does not exceed its thickness; but the superior tentacles, as well as the inferior, are comparatively much shorter in the articulate than in the non-articulate type. This atrophy of organs evidently depends upon a diminution

* We know no form governed by the law of metamerism having 3 metameres; but it is easy to see that such a form must once have existed, and that it, perhaps, still exists in some little-investigated sea. If it be found some day, we may predict with great probability, from the evidence of the forms with 2 and 4 metameres, that it will also have 4 tentacles (or $2\times n$) belonging to the inferior circle more atrophied than the rest. The genus *Triridium*, to which this hypothetical Hydroid must belong, is represented in fig. 1.

of their utility to the organism; for in the articulate type the tentacles, instead of fulfilling two functions at once, only perform one, namely that of defence against enemies. At the same time it has become possible for the organ to adapt itself better to the single function of defence than before, when it required also to capture food; it has attained the possibility of retaining the characters which are only useful for defence and which are even injurious to prehension. It is precisely this possibility of adapting themselves to the single function of defence that is the cause of the tentacles in the articulate type being very short and capitate at their extremity.

Imagine now a Hydroid reposing after a full meal, with its tentacles quietly expanded in the water and gently moved to and fro by the waves. When any enemy approaches it with hostile intentions and is inclined to attack it, the assailant must most certainly strike against the ends of the tentacles before it can touch the body of the Hydroid. Upon the effect produced by this first contact with the ends of the tentacles will depend all the subsequent actions of the enemy: if it receives a very strong charge it will be killed on the spot, or will make its escape as quickly as possible; in the contrary case, when the pain caused by the thread-cells arranged in the ends of tentacles is too insignificant, the enemy may arrive at the very body of the Hydroid, which is then menaced with great danger. We see, therefore, that, for the purpose of self-preservation, it is very important that the first line of fortifications, so to speak, should be as strong as possible—in other words, that the ends of the tentacles should be as formidably armed as possible, that there should be as many thread-cells as possible in these ends; for those which are placed in the other parts of the body and tentacles are not of equal importance for the purpose of defence. To fulfil all these conditions it is clear that the tentacles must be inflated at their extremities, in order that a great quantity of thread-cells may be accumulated in the enlargement. When once these tentacles have ceased to act as organs of prehension, it is no longer necessary that they should be long, fine, supple, and movable; this is why in the articulate type, at the same time that they acquire the capitate form, they also become much shorter than usual.

It generally happens that in those cases in which the body becomes very much elongated it acquires great flexibility and the faculty of twisting about very briskly, and so assists the proboscis in the capture of food, whilst, on the other hand, this organ in such cases also becomes strongly developed and very mobile. This flexibility of the body consequently re-

places the want of tentacles for the function of alimentation, as is very well shown in fig. 5, p. 64, of the 'History of British Hydroid Zoophytes' by Mr. Hincks, as well as by the description which accompanies it*. In the Hydroids without metameres, in which the body is consequently very short and not flexible, the tentacles are always filiform, long, fine, and very supple; their length sometimes even becomes very great, as, for example, in *Monobrachium parasitum*, mihi†, which has only a single tentacle.

This, then, is the explanation that, I think, may be given of the fact that the articulate type of the Hydroids is associated with short and capitate tentacles.

This view is further supported by the fact that the capitate tentacles are exclusively met with in the order Athecata, or the Gymnoblastic Hydroids—that is to say, among the naked Hydroids,—and that, on the contrary, in the order Thecaphora, in which each hydranth is furnished with a hydrotheca or calycle of chitine within which it can entirely withdraw itself, and which often may even be closed by a small operculum, we only find filiform tentacles. This is very easily explained, seeing that these Hydroids, which are very well defended from all attacks of their enemies by the hydrothecæ, within which they can conceal themselves in case of danger, have no necessity for organs so well designed for defence as are the capitate tentacles. On the other hand, as the Thecaphora grow in very numerous colonies, the number of individuals sometimes exceeding 1000, it is necessary for them to adapt themselves to the possibility of procuring food in sufficient quantity for so great a number of individuals living together. This adaptation in the case in question consists in the number of long, fine, filiform tentacles appropriated to prehension with which each individual is provided becoming very great, greater than it usually is in the naked Hydroids. (There are generally not fewer than 16, most frequently 20, 22, 24, and sometimes 30, 32, or more.)

Finally, I may mention another fact, which will serve in

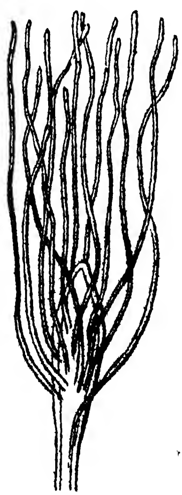
* In fact the flexibility of the body of such Hydroids as *Cladonema radiatum*, *Stauridium productum*, and others is excessively developed, and may very well compensate for the want of filiform tentacles in the function of prehension of nourishment. But it is especially in *Clavatella prolifera* that the length, contractility, and flexibility of the body have attained their maximum; and it is, I think, by this cause that we may explain why it also has capitate tentacles, although not belonging to the articulate type. It furnishes the only example of capitate tentacles in a non-articulate type.

† See my paper, "On a new Genus of Hydroids from the White Sea," in this journal for September 1877, ser. 4, vol. xx. p. 220.

support of the explanation above given of the forms with capitate tentacles. I refer to the blastostyles of the genus *Hydractinia.* It is well known that the gonophores, or sexual individuals, appear upon the surface of the body of the trophosomes, or nutritive individuals, which are furnished with several filiform tentacles. When these gonophores appear, the individual upon which they are seated, and which is then called a "blastostyle," becomes much thinner and smaller (the material of the animal being absorbed by the sexual bodies), the mouth closes, and the tentacles (which, from this moment lose their importance as organs subserving the purpose of nutrition, since the mouthless individual cannot feed) become shorter and shorter and more and more insignificant. Soon we can only perceive a few knobs or tubercles furnished with a great quantity of thread-cells, greatly resembling the dilatations with which the capitate tentacles are furnished. At the same time these tentacles or tubercles only retain the function of defence from enemies.

But I have said that there are exceptions to the rule that articulation is associated with capitate tentacles, and that these exceptions are not contradictory to the explanation that I have given; on the contrary, it is possible to explain these exceptions only by admitting all that I have said above.

Fig. 7.



Cordylophora lacustris.

There are some forms, evidently belonging to the articulate type, which do not possess capitate tentacles, but, on the contrary, have those organs slender, filiform, and very long. For example, *Clava**, *Cordylophora*, &c. (especially *Cordylophora*) have tentacles longer than in any other species. This is to be explained as follows:—In becoming developed into the articulate type the Hydroid became more and more elongated, whilst the tentacles remained the same, which rendered them relatively shorter; and it is precisely this that induced their capitate form. But if we assume that all the time the elongation of the tentacles proceeded side by side with the elongation of the body, we shall see that their original significance, as aiding in alimentation at the same time as for defence,

* Especially *Clava leptostyla*, Ag. (A. Agassiz, Illustr. Cat. Mus. Comp. Zool. ii. p. 170, fig. 274). In the cases in which the tentacles are not too long we may admit that these species have only become articulate

must remain intact; for in proportion as the body became elongated, the tentacles lengthened likewise, so that they could always reach the mouth and convey food to it (fig. 7).

But if the functions of the tentacles did not undergo any change, we need not expect them to change their form, except perhaps to become longer. This is what we remark in such forms as *Cordylophora*, *Clava*, &c., in which the lowest tentacles are not in the least shorter or less developed than the upper ones; on the contrary, they are sometimes a little longer; and in all cases they are all, without exception, longer than the body, owing to which they all have the faculty of assisting in the capture of prey, as has been very well described by Van Beneden in the case of *Cordylophora**.

I must still mention an articulate type, represented by the genera *Tubularia*, *Acharadria*, *Corymorpha*, *Pennaria*, &c., in which the superior metamere has the tentacles capitate, but much less developed than those of the other metamere. All these forms are derived from a non-articulate form with tentacles so well developed, so long, and in such *great quantity*, that when the formation of the second metamere was induced by some cause, the tentacles belonging to it were perfectly useless to the organism, which caused them to become atrophied, and at the same time capitate—that is to say, adapted solely to the defence of the organism (fig. 8). As the Medusa may be regarded as a hydranth reversed, and in which the tentacles (radial canals) are united together by a gelatinous substance (ectoderm or bell), it may be understood that the Medusæ which have tentacles at the extremity of the manubrium belong to the same articulate type as *Tubularia*, *Acharadria*, &c., with two metameres, the inferior of which is more strongly marked than the upper.

Fig. 8.

Acharadria larynx.

To complete this morphological chapter I propose to explain in a few words a point of view from which I regard all the

quite recently, and that they are in process of forming capitate tentacles, or of lengthening them. Thus Mr. Allman remarks, "Some Hydroids with filiform tentacles show, like *Clava squamata*, a tendency to the terminal enlargement of the tentacles in certain states of contraction" (Allman, Mon. Gymnobl. Hydr. p. 245).

* Van Beneden, 'Faune littorale de Belgique,' Polypes.

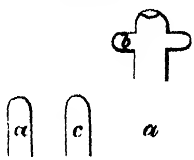
forms and in general all the morphological facts presented by the Hydroids, and which I think may contribute somewhat to the better comprehension of the idea of the Hydroid, so to speak, and to concentrate all the differences presented by this group in a single representation.

Every one at present regards a hydranth, with its tentacles, as a single individual, furnished with organs radially arranged. For my part, I believe we must regard such an organism, not as an individual, but as a colony composed of two kinds of individuals—the one kind appropriated to the function of seizing food, with the gastral cavity but slightly developed, without a mouth, very flexible and thin (*tentacles*); the other destined exclusively to nourish the whole colony, furnished with a mouth, and with a large cavity in the body which is but slightly flexible (*the actual body of the hydranth*). We should thus have a polymorphic colony after the fashion of the Siphonophora; and this polymorphism is explained here also by adaptation to different functions by the division of labour. Certainly before this division of labour was effected the colony only consisted of similar individuals, produced from the parent individual by gemmation; and it was then that the individuality of each individual must have been most strongly marked; but in course of time, in proportion as the division of labour was effected, this individuality was effaced, and the whole acquired more or less the character of a single individual furnished with several organs. This is what we see now-a-days. Therefore, in saying that the hydranth must be regarded not as an individual but as a polymorphic colony, I do not wish by any means to say that each tentacle is a true individual, but only that it has been so formerly, and that it has retained [this character] in part even to the present day. I may, moreover, urge the enormous difference which exists between the organ tentacle and the organs of other animals—a foot, for example, and still more the hand of man; this difference is profound and primordial (*principielle*), because a hand (or, in general, any organ) is not homologous with a tentacle, and is only analogous to it in its physiological function.

Such a view as this would perfectly explain the origin of the organ tentacles, which would be merely the result of the reproduction of a *Protohydra*, Leuck., or rather an *Archhydra*, Häck., by the process of gemmation. From this point of view, therefore, I must give the name of individual to each *axis* of cylindrical form, composed of ectoderm and endoderm; and it is very remarkable that any Hydroid, however complicated it may be, appeared at first precisely in the form of a

cylinder with a single diplopolar axis, in this respect differing in no way from the first appearance of a tentacle upon a hydranth, or of a medusa. In fact it is impossible to distinguish a tentacle, a medusa, and a hydranth at the first moment of their appearance (fig. 9); each of them is merely an *Archhydra* or a *Protohydra*, which, if we accept the biogenetic law, leads us to believe that they are all different modifications of a single primitive organism, and that they are all homologous.

Fig. 9.



a. Young hydrotheca.
b. Young tentacle.
c. Young medusa.

At any rate, I believe that to regard a (stauraxonic) hydranth as a colony of (monaxonic) *Archydræ* is to look at the affair as it is fundamentally.

Let us further remember two interesting Hydroids, namely *Ophiodes mirabilis** and *Ophiodes parasiticus*, Sars†, which, besides the tentaculiferous individuals (colonies according to me), have monaxonic individuals, without tentacles, and absolutely presenting no difference from the tentacles of certain Hydroids. And this case proves further that the tentacle (an individual), which cannot serve the colony either by procuring or by digesting food, only remains useful to it by serving to defend it, a function which induced the capitate form of the tentacles. In fact, the monaxonic individuals have no mouth, and therefore do not aid in nutrition; and, at the same time, they are often placed so far from the colony-individuals that they cannot serve for seizing food. The function of defence, therefore, alone remains for them; and we find that they have acquired the capitate form, which we have seen to be appropriated to defence.

II. *Remarks on the Reproduction of* Obelia flabellata, *Hincks.*

Among about forty species of Hydroids that I have observed and collected in the White Sea, *Obelia flabellata*, Hincks, is very frequently met with. At the end of the month of June I found it with a great quantity of gonothecæ, all filled with young Medusæ in various stages of development. Although in all other respects the *Obelia flabellata* of the

* Hincks, Mon. Brit. Hydr. Zooph. pl. xlv. fig. 2, p. 231.

† G. Sars, "Bidr. til Kundsk. om Norges Hydroider," Förh. i Vidensk. Selsk. i Christiania, 1873, p. 109, pl. iv. figs. 5–8.

White Sea did not differ at all from that described by Hincks*, the gonotheca was distinguished by the absence of the little tubular elevation placed upon its flattened summit, of which I never observed any trace; nevertheless it can only be regarded as a feeble arctic variety of the British *Obelia flabellata*.

The development of the Medusæ has been studied principally by L. Agassiz†, who was the first to publish some important facts, and by F. E. Schultze‡, as well as by Mr. Allman (the last on *Corymorpha nutans*), who have made some alterations in the views current before their time. But as most attention has been paid to the Medusæ belonging to the order Athecata, I have thought that it might not be altogether without interest to have their results confirmed by a Medusa belonging to the quite different order Thecaphora.

Plate XIII. fig. 1 shows the first commencement of a Medusa, which only consists of a protuberance (expulsion) of the walls of the blastostyle, composed, like the latter, of two layers, the ectoderm and endoderm, separated from one another by a very thin layer, which is not so distinctly contoured as in the buds; it is, no doubt, the hyaline intermediate layer between the ectoderm and endoderm which Schultze calls the "Stützlamelle." In form, this bud differs in no respect from a young hydranth developed from a planula; and both have exactly the same form as *Protohydra Leuckartii*, Greef, and the same as must have been possessed by Häckel's *Archhydra*§, *i. e.* if we choose to accept Häckel's biogenetic law. The next stage is represented in fig. 2 (Pl. XIII.); we see that the bud has considerably widened, and that the ectoderm (which is here also distinctly separated from the endoderm by the double-contoured line) has become much thicker at the summit of the bud than elsewhere. The thick part, which is in the form of a cone, is turned downwards towards the endoderm, in which the cone buries itself; the inner surface of the endoderm and also the general cavity of the body retain their original form: they do not form any expulsion; and their apex is always hemispherical. But, at the same time, we already remark that the depression of the outer surface of the endoderm is not a regular cone, but, on the contrary, that the edges of this depression are dentate. There are four teeth formed by the superior layer of the endoderm, and between these teeth four depressions occupied by the inferior layer of the ectoderm. It

* 'History of British Hydroid Zoophytes,' i. p. 157.
† 'Contributions.'
‡ 'Ueber den Bau der *Syncoryne Sarsii*,' 1873, p. 27.
§ It is his form "monaxonia diplopola inarticulata."

is easy to see that the first stage consists in the depression of the ectoderm (it is the latter that is active here), and that the first indications of radial canals are not the result of the *expulsion* of the endoderm into the ectoderm, but, on the contrary, of the *impulsion* of the ectoderm into the endoderm. The latter continues quite passive; it submits to the action of the ectoderm, which of itself begins to thicken, and by this means to bury itself in the endoderm. The following stages (figs. 3, 4, and 5) are only the more advanced stages of the process which we have already analyzed: the ectoderm becomes more and more developed, at the same time that it buries itself in the interior, leaving in their place only the four spots, which thus become converted into radial canals. In fig. 3 the apex of the cavity is already excavated, and there are faint indications of the four canals (only two are represented); but speedily this cavity again becomes convex, and it is from this moment only that the endoderm becomes active; it thickens in the middle (fig. 4), and begins in its turn to penetrate the ectoderm in order to form the manubrium. In fig. 5 we see the same stage with the four canals. It will be seen that between the two neighbouring canals there is only a uniform layer of ectoderm in which they are immersed, which proves that F. Schultze is right in not admitting any intermediate layer between the canals and distinct from the ectoderm, as was done by Agassiz. After all this, according to F. Schultze, the ectoderm itself splits into two layers, one of which produces the muscular sac belonging to the umbrella, and the other forms the superior layer of the manubrium*. Unfortunately various circumstances drew me away from these observations; so that I have not seen the stage intermediate between fig. 5 and fig. 6, in which the Medusa is ready to detach itself.

As the Medusa of *Obelia flabellata* is, so far as I know, undescribed, I will give a short account of it. Pl. XIII. fig. 7 represents a mature example, and shows that this Medusa differs very little from other Medusæ of the same genus, as, for example, that of *Obelia dichotoma* figured by Hincks †. The umbrella is very flat, but slightly campanulate, without thread-cells, with four radial canals, four oval sporosacs filled with ova and placed at the extremities of the four canals, where they unite with the circular canal, and where conse-

* By this the development of the Medusa of *Obelia flabellata* differs from that of *Corymorpha nutans*, in which the division of the ectoderm takes place sooner, as early as the first indications of the radial canals (Allman, Monogr. Gymnobl. Hydr. p. 77).

† *Loc. cit.* pl. xxviii. fig. 1, *c*, *d*.

quently the nutritive material attains its maximum abundance; for here the current of the radial canal unites with the current of the circular canal. The margin of the Medusa is furnished with eight lithocysts and a great quantity (more than thirty) of short tentacles, which are only sixteen in number at the moment of liberation. The manubrium is short, changes much in form, and is furnished at its orifice with four rounded lobes. The size is very variable, but it is usually about 6 millims. in diameter. It is completely colourless, whitish; the sporosacs are slightly yellowish. By leaving in a marine aquarium a branch of *Obelia flabellata* with gonothecæ, one can always obtain as many Medusæ as one wants. Fig. 7 *a* shows a Medusa of the natural size.

The ova are large, of irregular form (Pl. XIII. figs. 8, 9, 10), with a very thin membrane and granular contents. In the middle, or more frequently near the margin, we always observe very distinctly a large, clear and non-granular nucleus, more regular than the ovum itself. In the nucleus we always observe one or several nucleoli, and in each nucleolus a nucleolulus. All these formations are distinguished from each other by their behaviour with transmitted light; when the first of them is lighter, the second is darker, and the third again lighter. On changing a little the focal distance of the microscope all is changed; what was dark becomes lighter, and *vice versâ*. In the youngest ova we see only one nucleolus and one nucleolulus (fig. 8); the latter is usually very variable in its form, which is most frequently irregular. Sometimes it is very large (fig. 11, representing a nucleus very much enlarged). Further, we see ova in which the nucleolus has acquired a biscuit-shape, in each half of which we observe a nucleolulus which has evidently divided into two (figs. 9, 14). A subsequent stage may be seen in fig. 10, in which the nucleolus is completely divided and each half contains a nucleolulus. A still more advanced stage shows (fig. 12) a nucleus with four nucleoli, each containing a nucleolulus, which is very large and variable in form. The form changed before my eyes with considerable rapidity, and the whole moved like a little *Amœba*. Lastly, the succeeding stage that I have been able to observe (fig. 13) is furnished with a nucleus with a great quantity (about twenty) of nucleoli, almost every one of which contained a very small nucleolulus, which, however, it was sometimes impossible to define.

It is evident that all these nucleoli have originated from a single one by division, and that this division was always preceded by the division of the nucleolulus into two. Only

once I observed in a perfectly round nucleolus more than one nucleolulus, or rather a single nucleolulus in the centre surrounded by five or six very small granules forming an aureole round the centre.

As I observed all these stages of development in ova which had not issued from the sporosac, and, moreover, there was not a male individual in the neighbourhood, all the processes described took place in ova not yet fecundated. It would be interesting to know why there is all this enormous complication. But as yet the facts are too few to permit us even to think of an explanation.

Lastly, this hydroid has offered me another interesting fact which I will mention. For the purpose of observing the development of the Medusæ I placed a branch of *Obelia flabellata* upon a slide, and laid over it a covering-glass; the sea water by evaporating became salter and salter, which (and perhaps also the want of oxygen) appeared to affect the organism in a singular manner. In a short time I remarked that the cœnosarc of the stem detached itself in fragments of different sizes, especially near the end. First of all there appeared a constriction in a particular spot; this constriction became deeper and deeper; and finally the two parts separated entirely, so that the end of the stem formed a fragment quite independent of the colony. The two parts contracted, moved away from each other, and became rounded at their ends, so as to leave no trace of their lesion (Pl. XIII. fig. 16); the ectoderm and the endoderm recurved at the newly formed end just in the same way as in the end of the stem: the cavity was very distinct; and I could even observe the movement of nutritive granules, which I also saw in perfectly fresh specimens. Except wanting the mouth and cilia, this little cylinder much resembled a planula. In fig. 17 is represented a hydrotheca not yet completely developed, closed at its future aperture, in which the cœnosarc is contracted, not into a cylinder, but into a perfectly regular globular form, with a cavity, and surrounded by two layers. At one spot a very fine and colourless membrane, evidently produced by the ball, is seen to detach itself; this, no doubt, is a new layer of perisarc formed by the ectoderm; and I believe that in the other cases the perisarc is also present, but that in them it adheres very closely, for which reason it cannot be perceived.

What is the signification of these structures? For what purpose are they formed? Is it not a sort of encysting, analogous to the process so often met with among the Infusoria? Are not these fragments of the Hydroid the result of its dismemberment, caused by the evaporation of the water?

and is it not their function to survive these unfavourable conditions and thus serve, not only for the preservation of the individual, but also for propagation?

I think we may answer all these questions in the affirmative, and regard these fragments as formations analogous to what is known to us from Prof. Allman's * observations on the spontaneous fission of *Schizocladium ramosum* and *Corymorpha nutans*, as a means of reproduction by fission. In *Schizocladium ramosum* the upper portion of a branch becomes detached as a little cylinder, just in the same way as in *Obelia flabellata*; and then, after having ruptured the perisarc, this free portion departs from the colony, forms the perisarc again, and becomes transformed into an individual.

[To be continued.]

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

April 11th, 1877.—Prof. P. Martin Duncan, M.B., F.R.S., President, in the Chair.

The following communications were read:—

2. "The Bone-caves of Creswell Crags."—Third Paper. By the Rev. J. Magens Mello, M.A., F.G.S.

In this paper the author gave an account of the continued exploration of these caves, and of the completion of the examination of the Robin-Hood Cave, noticed in his previous communications. Five deposits could be distinguished in the Robin-Hood Cave, namely, when all present:—

1. Stalagmite, 2 ft.
2. Breccia, with bones and flint implements, 1 ft. 6 in.
3. Cave-earth, with bones and implements, 1 ft. 9 in.
4. Mottled bed, with bones and implements, 2 ft.
5. Red sand, with bones and quartzite implements, 3 ft.

Variations both in thickness and in character occur in different parts of the cave. The surface-soil yielded traces of Romano-British occupation, such as enamelled bronze fibulæ, fragments of pottery, &c. The most important discoveries were made in the cave-earth; and chief among these was a fragment of bone, having on it a well executed outline of the head and neck of a horse, the first recorded discovery of any such work of art in this country. The cave-earth also yielded a canine of *Machairodus latidens*, hitherto obtained in England only in Kent's Hole. Numerous remains of the Pleistocene Mammalia already recorded were found, together with a great

* Allman, "Reproduction by Fission in Hydroids," Brit. Assoc. Report, 1870; and Quart. Journ. Micr. Sci. 1871, pl. ii. figs. 2, 3.

number of implements of quartzite and flint, and two of clay-ironstone. The quartzite implements were most abundant in the lowest bed.

In the other cave examined, the Church Hole, which consists principally of a long fissure in the south side of the crags opposite Robin Hood's Cave, the succession of beds was nearly the same as in the latter. In the surface-soil near its mouth a fine bronze brooch was found. Some of the implements met with in the cave-earth were of great interest, and several of them were of bone. Bones of Rhinoceros were found in great abundance; and those of the Mammoth, Horse, &c. were also plentiful.

As the result of the exploration of these caverns, the author said it is evident that during the Pleistocene period Derbyshire and the adjoining counties were inhabited by a very numerous and diversified fauna, the vast forests and pastures which extended far to the east and south offering a congenial home to the Mammoth, the Woolly Rhinoceros, the Hippopotamus, the Irish Elk, the Reindeer, the Bison, and the Horse, whilst among them the Hyæna, the Glutton, the Bear, the Lion, the Wolf, the Fox, and the great sabre-toothed *Machairodus* roamed in search of prey; and that with these and other animals man lived and waged a more or less precarious struggle, amidst the vicissitudes of a varying climate, sheltering himself in the numerous caves of the district, which were already the haunts of the hyæna and its companions.

3. "On the Mammal-fauna of the Caves of Creswell Crags." By Prof. W. Boyd Dawkins, M.A., F.R.S., F.G.S.

In this paper the author gave an account of the remains found in the caves explored by the Rev. J. M. Mello. He stated that the recent explorations had proved that the Robin-Hood Cave was inhabited by Hyænas, not only during the deposition of the cave-earth and breccia, but also during that of the red-sand and clay underlying it, which had also furnished traces of the existence of man. An immense number of specimens were collected in this cavern, including bones of the following animals:—*Machairodus latidens*, Cave-Lion, Wild Cat, Leopard, Spotted Hyæna *, Fox *, Wolf, Bear, Reindeer *, Irish Elk *, Bison *, Horse *, Woolly Rhinoceros *, Mammoth *, and Hare *—those marked with an * occurring in the red sand and clay as well as in the cave-earth, although much more sparingly. The traces of man consisted of more than 1000 implements; and, as before, those made of quartzite were generally found in the lower strata. The most important indication of human handiwork was the outline of the head and fore quarters of a horse, engraved upon a fragment of the rib of some animal. Among the animal remains the most interesting discovery was that of a canine of *Machairodus latidens*; it consisted of the sabre-shaped crown only, which appeared to have been purposely broken away from the root.

The superficial layer of earth in the cave contained remains be-

longing to the historic and prehistoric ages, including a Romano-British enamelled bronze brooch, of the same pattern as one found in the Victoria Cave, fragments of pottery, human bones and teeth, and bones of both wild and domestic animals.

The distribution of the remains found in the Church Hole Cave agreed generally with that above described; traces of human occupation and remains of the Hyæna occurred both in the cave-earth and in the red sand and clay. The bones found indicated the following animals:—Lion, Polecat, Hyæna, Fox, Wolf, Bear, Reindeer, Irish Elk, Bison, Horse, Woolly Rhinoceros, Mammoth, and Hare—all common to both the cave-deposits, except the Lion, which was found only in the cave-earth, and the Polecat, of which a single jaw occurred in the red sand. The latter contained a larger proportion of the remains than in the Robin-Hood Cave; but, as in the latter, the quartzite implements were more abundant in the lower strata of the deposits. Among the articles of human workmanship was a perfect and well-shaped bone needle. The superficial soil of the Church Hole Cave also contained articles of the historic and prehistoric age, including a bronze fibula, fragments of pottery (one mediæval), and bones of man and animals. From the presence of these objects in the surface-soil the author inferred that the caves of Creswell Crags, like those of Yorkshire and elsewhere, were used as places of refuge by the Brit-welsh during the conquest of the country by the English.

After noticing the conditions of the fossil bones found in the caves, the author proceeded to remark upon the general results of the explorations with regard to their Pleistocene fauna, and concluded that there is no evidence from these or other caves in this country to prove that their faunas are either pre- or interglacial, and that we have no proof of the existence of pre- or interglacial man in Britain.

MISCELLANEOUS.

On the Migrations and Metamorphoses of the Tapeworms of the Shrews. By M. A. Villot.

Dujardin discovered and described several species of tapeworms inhabiting the intestines of the shrews: thus *Tænia scutigera* lives in *Sorex tetragonurus*; while the little *Sorex araneus* harbours three species, namely *T. scalaris*, *tiara*, and *pistillum*. Dujardin was acquainted with the various stages of the development of these species, except the place and manner of the passage from the proscolex to the scolex, a gap in our knowledge of their history which M. Villot has filled up by the discovery that this change takes place in *Glomeris*, and that the cystic parasite described by him last year under the name of *Staphylocystis biliarius* represents this stage in the development of a species very near to *T. scutigera* and *T. scalaris*, which, moreover, are very closely allied. In these two species, according to M. Villot, the hooks are of the same form and dimen-

sions, measuring from 0·033 to 0·040 millim. Their number is ten in *T. scutigera*, twelve in *T. scalaris*. *Staphylocystis biliarius* usually has fourteen hooks, which also attain a length of 0·040 millim. The difference in number is so small that it may be a question whether Dujardin did not observe individuals of a single species which had lost more or less of their hooks. M. Villot unhesitatingly refers his *Staphylocystis micracanthus* to *Tænia pistillum*. He sums up his results as follows:—

It is now easy, taking into consideration the habits of their successive hosts, to summarize the history of these parasites. The proglottids, adult individuals, loaded with ova and embryos, detach themselves from the strobile and escape from the intestine of the shrew along with the excrements: then the embryos pierce the envelopes, and, having got free, wait patiently in the moist ground on which they have been deposited for the moment when they can introduce themselves into the body of the *Glomeris*. Their migration must, in the first place, be purely passive; for we cannot otherwise understand the important fact that the Staphylocysts are always attached to the Malpighian tubes. They probably pass into the stomachs of their hosts along with the half-decomposed vegetable débris upon which the latter feed. At the entrance of the intestines the embryos may get into the biliary vessels, travel through these for some time, and then traverse their walls, to take up their abode in the adipose tissue which surrounds those organs. Arrived at their dwelling-place they lose their hooks, which have now become useless, pass into the vesicular state, proliferate, and become scoleces. A shrew meeting with an infested *Glomeris* will devour it as readily as another, introducing into its own stomach at once a hundred scoleces, which on arriving in the intestine of the insectivore will attach themselves, and in their turn bud and form strobiles. The proglottids of the latter will acquire genital organs, and give birth to a new generation.—*Comptes Rendus*, November 19, 1877, p. 971.

On some Monstrosities of Asteracanthion rubens. By M. A. Giard.

On the beach at Wimereux, where the common starfish (*Asteracanthion rubens*) is excessively abundant, especially during the winter and spring months, we find pretty frequently among these animals various interesting monstrosities. Thus we may every year obtain many individuals possessing six rays, instead of five, the normal number.

As the number of rays varies in the group Asteriadæ in allied species, and sometimes even in a particular species, it was natural to see in these aberrations either a simple case of *polymelism*, or a numerical variation in the constitution of the *cœnobium*, according as one gave to each ray of a starfish the value of a member or that of an individual.

There is no doubt that a good many of the six-rayed *Asteracanthions* are really monstrosities of this kind. In fact we find, from time to time, specimens in which one ray is bifurcated about the

middle, or only in the outer fourth; and we may explain, by a similar division taking place at the level of the disk, the numerous cases of *hexamelism*, in which, except in the number of rays, we find nothing abnormal in the constitution of the starfish.

But this is not always the case. I have long since expressed the opinion that the radial symmetry of the Echinoderms is only apparent, and that the *antimera* of those animals are arranged in accordance with a quincuncial spiral, in such a fashion that an urchin or a starfish may be compared, from the point of view of general morphology, not to a regular corolla, but to those flowers which are symmetrical with respect to a plane, such as those of the Papilionaceæ or Labiatæ. In the latter, in fact, there exists a combination of bilateral symmetry and of the spiral arrangement which we also meet with in the Echinoderms. Starting from this notion I wished to see whether the anal glands of *Asteracanthion rubens* had not the same morphological value as one of the pairs of hepatic cæca. For this purpose I opened a certain number of specimens with six arms, and saw, with surprise, that several of them presented two sand-canals terminating at a single madreporic plate, which, however, was formed by the union of two plates. Consequently I had before me true double monsters. Couch, the excellent author of the 'Fauna of Cornwall,' has described* a specimen of *A. rubens* (which, following Fleming, he calls *A. glacialis*), possessing eight rays. This individual presented three madreporic plates, forming the three angles of a triangle inscribed between the bases of four rays; the four other rays were outside this triangle. This specimen was therefore a triple monster, evidently of rarer occurrence than the double monsters of which we have just been speaking, but perfectly analogous to them.

From the preceding statement it follows that the examples of *Asteracanthion rubens* possessing more than five arms may be likened sometimes to the cœnobia of *Botryllus*, in which the number of unities constituting the cœnobium varies from one *cormus* to another, and sometimes in the same cormus; and sometimes to the compound cœnobia of the genera *Amarœcium* and *Polyclinum*. In other words, they are sometimes double monsters, sometimes simple cases of polymelism. It is remarkable that these two distinct cases, presented in a teratological form in *Asteracanthion rubens*, also exist in the normal state in the group of Echinoderms. The *Solasters*, for example, have a variable number of arms, but only a single sand-canal; while some examples of *Ophiactis* have several sand-canals, and are even capable of multiplying by a spontaneous scission of their compound cœnobium into several independent colonies.—*Comptes Rendus*, November 19, 1877, p. 973.

On the Feeding of Dinamœba.

Prof. Leidy remarked that bias frequently proved to be an obstacle in the way of research. In his study of the Rhizopods he had repeatedly watched different kinds of *Amœba* for long periods with

* Mag. Nat. Hist. 2nd ser. no. 27.

the view of ascertaining their usual mode of feeding. Ordinary experience had prepossessed him to direct his attention to the fore part of the body (that is to say, the part in advance in the movements of the animal) as the point at which food would be taken. He had been surprised at the rarity of the occurrence in which he had seen *Amœbæ* swallow food when the apparent greediness of the animal was taken into consideration. In the last number of the 'Popular Science Review' there is an interesting article by Dr. P. M. Duncan, entitled "Studies amongst *Amœbæ*." From this he learned, from the observations of Dr. Duncan, that the *Amœbæ* habitually take their food at what may be considered the posterior part of the body. With this hint he examined specimens of the curious amœboid animal described under the name of *Dinamœba*, of which he had recently obtained a good supply from the ditches of a cranberry-field at Atco, New Jersey. He had since on several occasions had the opportunity of seeing the *Dinamœba* take its food, which was done, as indicated by Dr. Duncan, at the posterior part of the body. One instance appeared to him to be particularly interesting, and was related as follows:—

Seeing a specimen of *Dinamœba* with its left side in contact with a filament of the alga *Bambusina Brebissonii*, he was led to watch it. On closer examination it proved that the alga entered to the left of the tail and extended through the body, causing a slight bulge of the ectosarc by its other end to the left of the head. The *Dinamœba* became slightly elongated, and the alga sunk more inwardly from behind. The former moved with an inclination to the right, causing the alga to assume an oblique position from left to right. The anterior end of the alga suddenly protruded from the body of the animal, so that this appeared to be pierced by it. In this condition the alga entered the *Dinamœba* to the left of the tail and protruded at the right of the head. Gradually the alga was made to assume a transverse position. The right extremity of the alga now became depressed and the left elevated, so that the alga assumed nearly its original position, in which it appeared to perforate the left border of the animal obliquely from the tail end. It gradually acquired a central position, penetrating the animal from tail to head. The *Dinamœba* now elongated at both ends, a third greater than its former length, extending in a fusiform manner upon the alga. The animal next doubled upon itself, so that both ends of the alga approached in front and protruded side by side from the head. One extremity of the alga then sunk within the *Dinamœba*, and subsequently the other extremity, so that the filament, about three times the length of the animal, became coiled up within it.

The observation of swallowing the *Bambusina* was made in the afternoon of September 15. In the evening, several hours after the first observation, on looking at the *Dinamœba*, which had been preserved in an animalcule-cage, it was observed sitting, as it were, on a large filament of the alga *Didymoprium Grevilii*. The posterior end of the animal extended as a cylindrical expansion along the alga to a greater length than the breadth of the body of the

Dinamœba, and so closely clasped it as to contract the gelatinous envelope of the alga to little more than the thickness of the green cells. After some time the alga suddenly broke, and the two portions were gradually bent backward and made slowly to approach. so as to become parallel with each other. One of the pieces was then drawn within the animal a convenient length, broken off, and completely swallowed, and this was followed by a similar movement of the other piece. Shortly after the first rupture of the alga, when the two portions projected at an obtuse angle from the back portion of the *Dinamœba*, the animal contracted in length, and discharged from the right side a mass of bodies, which consisted of the separated cells of *Bambusina*, probably from the filament it had swallowed in the afternoon.

Prof. Leidy remarked that the two successive observations on the feeding of *Dinamœba* appeared to be particularly fortunate, as they apparently explained certain facts in the habits of the animal. *Dinamœba* had been noticed to be especially fond of the alga *Didymoprium*; for it was found to be present as the principal element of the food in numerous specimens. *Bambusina* was less frequently found among the food contents of the animal. The algæ were equally abundant in the localities of the *Dinamœba*; and, from the observations detailed, it would appear that the *Didymoprium* is preferred as food from the comparative ease with which its filaments are broken into pieces of convenient size for swallowing.

The observations are, moreover, interesting from their indicating discrimination and purpose in the movements of one of the simplest forms of animal life. The movements are to be viewed as reflex in character, though resembling the voluntary movements by which the most intelligent animal would prepare morsels of food of convenient form to take into the mouth. In striking contrast were the movements, noticed on several occasions, by which an *Oscillatoria* obtained entrance into the empty shell of an *Arcella*, and there, coiled up, crept round and round incessantly.—*Proc. Acad. Nat. Sci. Philad.*, Oct. 1877.

On the Structure of Amphioxus lanceolatus. By Prof. Schneider.

The *longitudinal muscles* of the body-wall may be divided into the *longus dorsi* and *rectus abdominis*. The *rectus* reaches from the third segment to the anus, and lies beneath the chorda and within the *longus dorsi*. Its segments are the same as those of the *longus*; so that for the above extent each myocomma divides into a portion belonging to the *longus* and a portion belonging to the *rectus*. The laminæ of which, as Grenacher demonstrated, the fibrillar substance of the longitudinal muscles consists, converge in the *longus* towards the spinal cord; in the *rectus* towards a point situated outside the body—to the right for the right side, to the left for the left side.

The *nervous system* may be very beautifully isolated by the method described by Owsianikow, but only partially; and, indeed, Owsianikow's figure by no means shows the whole nervous system,

as was formerly supposed, but, besides the spinal cord and brain, only the upper sensory nerves. The inferior roots are best seen in transverse sections, as Stieda correctly states. The description of the nerves given by Stieda would be perfectly correct had he not started from the supposition that the nerve-roots lie only in the sheaths of the myocommata (ligaments). According to Stieda the nerves entering the ligaments would be alternately a sensory and a motor one. But only the former enters the ligaments; the motor nerves are interligamental. Behind each ligament originates an upper root, which soon enters the ligament and runs towards the skin. The fibres are very delicate, and united at their issue from the spinal cord into a round cord. There is no dilatation; small nuclei lying in the commencement of the cord probably represent the spinal ganglion. The motor roots behave differently. The envelope of connective tissue, which closely embraces the spinal cord, is furnished along its lower edge, and, indeed, in the entire posterior half of each myocomma, with apertures through which fibres of the spinal cord, the motor nerves, issue. The fibres proceeding from the apertures unite first of all into a flat cord, and then radiate upwards and downwards over the inner free edges of the fibrillar laminæ. Their direction crosses the edges. For each edge a fibre bends round in a wide curve, and applies itself thereto under a very acute angle. These fibres enter into the fissure between the *rectus* and the *longus dorsi*. Large specimens, 4 centims. long, present a remarkable appearance in the five segments following behind the anus. Those fibres which go to the upper half of the part of the myocomma lying below the spinal cord are converted into transversely striated muscular fibres from the laminæ nearly to the spinal cord. I use the term "converted" only for the more easy description of the facts. When the spinal cord is isolated by Owsianikow's method, the origins of the motor nerves appear upon it only as slight conical elevations.

The *heart* commences at the free end of the cæcum, runs along the upper edge of the latter towards the intestine, and, bending round, then passes along the ventral surface of the intestine towards the branchiæ. The part lying on the cæcum is at first a simple tube, then a system of from four to five parallel tubes repeatedly communicating with one another and possessing cæcal diverticula on both sides. The part situated by the intestine is again simple.

Of the *branchial rods* some, which are rather thicker, are cleft at the lower end, the others not. Besides this previously known peculiarity, they are distinguished by the form of the transverse section and the shape of the canal contained in them. The blood passes from the branches of the branchial artery first of all into the canal of the cleft rods, and thence through the vessels running along (not in the interior of) the transverse rods, into the uncleft rods.

The canals of the branchial rods open above into branchial veins, which, bending backwards and downwards, open into the aortas. From the aorta, which is double in the branchial part, although simple further back, there originates on each side interligamentally an upper branch to the longitudinal muscles, and ligamentally an inferior branch, which, running along the ligaments, ramifies upon

the surface of the ventral cavity. No breaking-up of these branches into capillaries, or union of them with veins, was to be detected.

Behind the branchial part, along the intestine, capillaries issue from the aorta on both sides without the intervention of arteries; and these spread out reticularly in the connective layer of the *muscularis mucosæ*, hereafter to be described. Their occurrence was detected by Langerhans. The intestinal vein is situated upon the same layer ventrally. It consists posteriorly of about five reticularly communicating parallel tubes; anteriorly the number is reduced until there is only one, which gradually narrows, and finally disappears at the commencement of the cæcum. From behind, as far as the region where some three tubes are present, short transverse branches, into which the capillaries open, are given off on both sides from the margin of the tubular system. Then follows a space without transverse branches or other openings for the capillaries, until finally, before the termination, transverse branches again occur; these receive no capillaries, but probably open freely into the lymphatic space, which has still to be described. The intestinal veins and their transverse branches are closely covered with transverse muscular fibres.

Joh. Muller, to whom a portion of these vessels was known, supposed that there was a vascular connexion of the intestinal veins with the vessel that I have called the heart; but nothing of the kind can be demonstrated.

The *intestinal canal* is formed by an inner and an outer layer. The inner layer consists of the intestinal epithelium and a *muscularis* composed principally of transverse fibres, which, therefore, may very well be regarded as a *muscularis mucosæ*. In its fundamental substance this layer contains the capillaries; and the intestinal vein is applied to its outer surface. The outer layer consists of the peritoneal epithelium and a muscular layer also composed of transverse fibres. At the spot where the intestine passes into the branchial region the muscles are particularly thick and partly transversely striated. Between these two layers, which may also be traced in the branchial part, there is a wide space. Its complicated structure has been described by Langerhans, and particularly accurately by Rolph. I can confirm his description, and only add to it that from the portion of this space which surrounds the branchial artery a branch may be traced along the outer surface of each of the cleft branchial rods to the section running above along the branchiæ. But whatever may be the development of this space, in adult animals it does not serve, as Rolph supposes, as a body-cavity, but as a venous or lymphatic space, which cannot well be separated in *Amphioxus*. It not only bears a great quantity of materials which coagulate in chromic acid and alcohol, but it also leads into the heart. The heart may be traced for some distance forward from the apex of the cæcum, where it then opens into the venous space running along above the branchiæ. Besides these largest and longest veins, there are shorter veins, which, on each branchial rod along the cæcum, enter the heart. These veins of the heart were seen by J. Müller, but regarded by him as bands between the cæcum and the branchiæ.—*Oberhessischen Gesellsch. für Natur- und Heilkunde, Giessen*, November 14, 1877.

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XXX.—*On the Genus* Haliphysema, *with Description of several Forms apparently allied to it.* By the Rev. A. M. Norman, M.A.

[Plate XVI.]

It is now many years since *Haliphysema* first attracted my attention; and well do I remember the extreme interest felt at finding the type of *H. ramulosum*, which was dredged off the Guernsey coast, attachedto a dead *Gorgonia verrucosa*, which came up laden with a forest of treasures growing on it.

The genus is now attracting considerable attention; and as I cannot entirely agree with some of the views either of Mr. Carter, on the one side, or of Prof. Haeckel on the other, I propose to give my reasons for dissenting from certain points which they hold with regard to the systematic position of these animals, or the relationship which exists between the known forms.

I feel the more called upon to state my opinion upon the questions at issue because I have undertaken to edit the fourth and last, posthumous volume of my late friend Dr. Bowerbank's 'Monograph of the British Spongiadæ.' It will be necessary, in the first place, briefly to trace the outlines of what has been written upon *Haliphysema* before entering upon an investigation of the views of different authors with respect to the species of this and allied genera which have fallen under their observation.

I. *History of the Genus* Haliphysema.

In the year 1862 Dr. Bowerbank first characterized the genus *Haliphysema*, in the third part of his memoirs "On the Anatomy and Physiology of the Spongiadæ," published in the 'Philosophical Transactions.' The characters given were as follows:—

"Sponge consisting of a hollow basal mass, from which emanates a single cloacal fistula. Skeleton: spicula of the base disposed irregularly; spicula of the fistula disposed principally in lines parallel to the long axis of the sponge, without fasciculation."

The type species was *H. Tumanowiczii*, Bow., figured pl. lxxiii. fig. 3. The author stated that he was unable to detect either oscula or pores, but held that the general structure of the organism showed relationship to *Alcyoncellum* and *Polymastia*. In the first volume of the 'Monograph of the British Spongiadæ,' the above-mentioned figure and description were reproduced; and there can be no question that up to the year 1865 Dr. Bowerbank held that the spicules incorporated in the structure of *Haliphysema* were the secretion of the animal, and not the product of other sponges selected by *Haliphysema* and built into its walls. It was in this year that I discovered in Guernsey a second species of the genus, *H. ramulosum*, and, sending it to Dr. Bowerbank for examination, called his attention to the masonic properties of the animal. In his second volume (1866), in describing *H. ramulosum*, he fully recognized "the selection and incorporation of the extraneous material of the skeleton," and, in his account of *H. Tumanowiczii*, described the pedicel and head as having "an incorporation of fragments of spicula of various sizes and forms and of minute grains of sand."

It seems extraordinary that after this, in one of his very last papers, Bowerbank should have described a sponge as belonging to this genus, of which he states that there are "no adventitious substances incorporated in the skeleton, as in the other two species, and all its spicula are undoubtedly secreted by itself"—a statement which seems fully borne out by his description and figures, and which renders it impossible that *Haliphysema tubulatum** should be retained in the genus to which it was assigned by its describer.

* Bowerbank, "Report on a Collection of Sponges found at Ceylon by E. W. H. Holdsworth, Esq.," Proc. Zool. Soc. 1873, p. 29, pl. vii. figs. 1–6. *H. tubulatum* appears to be a remarkable sponge, consisting of an agglomeration of very numerous elongated tubuli without terminal openings, closely appressed together and forming a mass nearly 3 inches long by 2 wide. The cylindrical tubuli, when separated from each

In 1868 Mr. Parfitt* described with accuracy the structure of the base or dome-shaped bulb by which the type species is attached to the seaweed or Hydrozoon on which it lives. This bulb, when carefully opened, Mr. Parfitt stated, has "five, six, or even seven radii, like the spokes of a wheel."

We now come to the observations of Mr. Carter, who, in 1870, having met with *Haliphysema Tumanowiczii* at Budleigh-Salterton, accurately described the test with its incorporation and garnishing of extraneous objects, consisting chiefly of sand-grains and both siliceous and calcareous spicules belonging to various species of sponges, which *Haliphysema*, by some wonderful collective and selective power, gathers together, and, clever builder as it is, appropriates and uses either for the purpose of strengthening its test or as weapons of defence, inserting them, in the latter case, into the walls of its dwelling, like pins stuck into a pin-cushion. Next Mr. Carter entered into a minute description of the chambered character of the discoidal base, thus confirming Mr. Parfitt's observation, of which, however, he does not seem to have been aware. Mr. Carter expected to find pseudopodia issuing from the minute rounded orifice which is situated at the distal end and immersed among the brush of terminal appropriated spicules; but he did not succeed in detecting them. Arguing, however, chiefly from the pseudo-septate structure of the adherent bulb-disk, he gave it as his opinion that Bowerbank's so-called sponge was no sponge at all, but a Foraminifer, which he assigned to Schultze's genus *Squamulina*, and called *Squamulina scopula*.

In the next number of the 'Annals' Mr. Carter made a few observations upon *Haliphysema ramulosum*, a specimen of which he had examined in the British Museum†. These specimens were sent to the Museum by Prof. Oscar Schmidt, having been collected by Count Pourtales on the coast of Florida.

Four months later Mr. Carter was fortunate enough to meet with *H. ramulosum* (or, as he calls it, a "branched form of

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other, are found to have their surface bristling with numerous acuate spicula, some of which are subflecto-attenuate and incipiently spinous, while other spicula, used for defence and as skeleton-spicula, are large flecto-attenuate-acuate and smooth. The latter spicula are of great size as compared with the diameter of the tubuli. Tubuli apparently devoid both of oscula and of pores. The sarcode is blood-red. I know of no genus into which this Ceylon sponge can fall, and will propose for it the name *Aulospongus* (αὐλός and σπόγγος); and the species will become *Aulospongus tubulatus* (Bow.).

* Trans. Devon Assoc. Sci. Literat. and Art, p. 14 (separate copy).

† Ann. & Mag. Nat. Hist. ser. 4, vol. v. (1870) p. 389.

Squamulina scopula") at Budleigh-Salterton, and made the following observations :—" On cutting off the branched head with a pair of scissors across the main stem, and placing it in a watch-glass, the truncated end soon after threw out a bunch of obliquely branching and anastomosing filaments or pseudopodia, to the extent of a sixtieth of an inch long, all round, which continued retracting and extending themselves and exhibiting the granule-circulation, after the manner of the sarcode of the Foraminifera, for six hours, when the whole were gradually withdrawn and did not reappear. Thus the Foraminiferous character of *Squamulina scopula* and its branched variety is proved. I could not see any filaments projected from the head in any of the specimens; nor would it be easy to do so, as these probably entwine themselves about the spicules which are always raised up from the bottom of the water; but the truncated end of the stem lay on the watch-glass, over which it was easy to see the extended filaments with a one-inch compound power" *.

Mr. Carter has also met with what he regards as another form of the same genus at Budleigh-Salterton. To this he has given the name *Squamulina varians*. It consists of a little rounded dome, commonly semiglobular, but varying much in shape, attached by its flat side to the fucus or other object on which it grows, having a test composed of colourless grains of quartz and sponge-spicules incorporated in a chitinous substance, with a slight admixture of calcareous particles. The dome is furnished with an extended margin, projecting beyond the body of the test, and terminating in a thin edge, the basis of attachment of the organism being thus greater than the size of the dome itself. A single rounded aperture is situated either at the base or summit, or anywhere between the two, and this aperture is somewhat funnel-shaped, widening outwards. Size seldom exeeeding 1-30th of an inch in diameter.

It is this *Squamulina varians* which comes nearest in general form to *Squamulina lævis*, Schultze; but, besides other differences, while the test of Carter's so-called *Squamulina* is arenaceous, that of the type of the genus is calcareous.

Squamulina varians is in general form very like the base of *H. Tumanowiczii* before the development of the column and clavate head; but unless it be the *immature* stage of that or of an allied species, it cannot take its position with them in *Haliphysema*.

But we have to consider the position of the type with refer-

* Ann. & Mag. Nat. Hist. vol. vi. (1870) p. 347.

ence to Mr. Carter's investigations. Even granted, for the sake of argument, that he has made out a strong case for the Foraminiferal, or, at any rate, Rhizopodal character of the animals constituting Bowerbank's genus *Haliphysema*, it appears to me that they have not the remotest claim to be included in Schultze's genus *Squamulina*. But on what principle has Mr. Carter changed the specific name and substituted *scopula* for the prior appellation given by Bowerbank, *Tumanowiczii*? There can be no justification for such a step. No one could possibly mistake the animal which was first described and figured; and the supposition that Dr. Bowerbank had assigned the dead tests of an obscure organism, which he had not observed in a living state, to a wrong class, is no justifiable reason for rejecting the specific name he gave. If errors in first description invalidated the names then assigned, where should we stop in changes of nomenclature? Confining criticism to the Protozoa, and not even there condescending to notice mistakes as regards single species or even genera, are all the Foraminifera to be renamed which were originally described as Mollusca? or the sponges which were regarded as plants? If Mr. Carter's mode of proceeding as regards *Haliphysema Tumanowiczii* is right, such wholesale alterations in nomenclature as I have hinted at would, on the same grounds, be allowable.

I was unable to regard the arguments which Mr. Carter adduced in favour of the Rhizopodal nature of these organisms as conclusive at the time when they were first published. The partitioned character of the base might perhaps be nothing more than a means of additional hold upon the body to which the test is attached, and of giving strength to the dome which supports the column. It is of importance, moreover, as bearing upon one of the arguments of Mr. Carter in favour of the foraminiferal nature of *Haliphysema*, to observe:—first, that he entirely failed to discover pseudopodial processes naturally extruded*; and, secondly, that though, on being cut in two, the injured parts did elongate themselves after the manner of pseudopodia, yet we have evidence that pseudopodial movements are quite consistent with sponge-structure. Haeckel, in speaking of what he calls the ectoderm, or animal germlamella of the young calcisponge, says that if torn mechani-

* Mr. Kent, in the 'Annals,' 1878, i. p. 14, speaks of Mr. Carter as "witnessing the protrusion of pseudopodia from the *terminal orifice* of the types in question." I am not aware that Mr. Carter has anywhere stated that he has witnessed such a protrusion, he only witnessed the extension of pseudopodium-like processes from the exuding syncytium which escaped from the pedicel of *H. ramulosum* when cut in two with a pair of scissors.

cally the fragments will take the form of *Amœba* and walk about, and that if the endodermal cells, which so closely resemble (if they be not actually) flagellate Infusoria, be liberated artificially they also will assume amœboid shape and motions. Mr. Kent, again, says that he has frequently observed "the withdrawal by the adult individual collar-bearing monad of the characteristic hyaline collar and the extension of pseudopodic processes," and is of opinion "that in a true sponge, agreeing in all structural details with the simple *Haliphysemata*, we should expect to find the sarcode or syncytial element protruded in such a fashion for the seizing of the fragmentary foreign particles out of which it builds up instead of secreting, as do ordinary sponges, a protective and supporting framework." Just so. The supposition of such protrusion is the only possible way of accounting for the wonderful building-feats of this creature. Where is the hand to be found to select, to grasp, to convey, and to arrange the spicula and sand-grains built into the walls, unless it be in the extension, flexibility, and retraction of extrusive portions of the sarcode or syncytium? Is such motion compatible with sponge-structure? and have we any thing like it in a universally acknowledged sponge which can serve as a precedent? The genus *Dysidea* or *Spongelia* affords an almost exact parallel, save that in that instance the extraneous material is taken into the interior of the organic parts instead of being built into their outer wall; or, in other words, it is used to form an internal skeleton instead of to furnish a dermal crust. The grains of sand which occupy the areno-fibrous structure of *Dysidea* must have been grasped, and placed in the position in which they are ultimately enclosed by the investing material, by a process similar to that employed in the case of *Haliphysema*; and sarcodic extension is the only grasping-instrument which we can conceive possible in animals presenting the organization of these genera.

I maintain, therefore, that the presence of pseudopodial action is not inconsistent with the position of *Haliphysema* among the sponges; and although such action has not yet been seen to take place from the body of the uninjured animal, we may pretty safely predict that it will hereafter be found to exist.

We now come to Prof. Haeckel's memoir, in which he has described and figured the presence of flagellate epithelium with its flagellate cells (*Geisselzellen*) as he calls them, or "collar-bearing monads" according to the views of those who differ from him. Presuming these observations to be substantiated, the theory that *Haliphysema* is a Foraminifer

of course falls to the ground. Haeckel's observations altogether appear to give the strongest confirmation to the opinion originally entertained by Dr. Bowerbank as to the position of this animal, though in the arrangement of genera it is very far removed from *Polymastia* on the one hand, and from *Euplectella* (= *Alcyoncellum*, Bow.) on the other, in juxtaposition with which its describer placed it. Taking Mr. Carter's to be the best classification as yet suggested for the Spongida, I should place the "*Physemaria*" of Haeckel as an order between Carter's Order II. *Ceratina* (= the horny-fibrous-skeleton sponges), and Order III. *Psammonemata* (= sponges having a skeleton composed of fibre in which sand is incorporated); and I would suggest as the name of such an order Psammoteichina (τεῖχος, a wall). The genera and species adopted by Haeckel will be noticed further on.

Mr. Kent's "Observations upon Prof. Haeckel's Group of the '*Physemaria*,' and on the Affinity of Sponges," published in the 'Annals' for last January, while it makes us anxious to see the full illustration of his views in the forthcoming memoir in the 'Linnean Transactions,' does not throw any special light upon *Haliphysema*, which he does not appear to have ever seen. His observations confirm those of Prof. H. James-Clark in every particular, carrying investigation further into those orders of the sponges in which Clark had not observed the presence of the "collar-bearing" monads. Prof. Clark found himself unable to do more than infer the position of the mouth, which he regarded as situated at the base, or close to the base, of the flagellum, to which place he believed that the particles of food were brought by the rotatory action of the flagellum. Mr. Kent assumes that the whole of the collar, "consisting of an exquisitely delicate film of sarcode, and exhibiting a circulating stream, ascending on the outside and descending on the inside," and "constituting a wonderful and most admirably constructed trap for the purpose of drawing towards it and arresting passing particles of food," "must necessarily be characterized as the oral or inceptive" organ. I would ask him to consider whether organs designed for the purpose of bringing food-particles within reach of the mouth are to be regarded as the mouth itself. The action of the collar performs, it would appear from his description, an office similar in function to that discharged by the cilia of the "wheels" of the Rotifera.

Lastly, we have the paper by Mereschkowsky upon *Wagnerella*, a highly interesting little sponge. But this animal, though in form assimilating closely to *Haliphysema*, apparently widely differs, since the spicules both of the stem and head are

the result of its own secretion, and not extraneous matter incorporated in the test. Attention may also be called to the fact that, whereas in *Haliphysema* the arrangement of the spicula in the pedicel is always parallel to the axis of the sponge, in *Wagnerella* the short acerates are uniformly arranged transversely to the axis.

II. *The Species of* Haliphysema *and its Allies.*

Order PSAMMOTEICHINA, Norman.

Genus HALIPHYSEMA, Bow.

= *Squamulina*, Carter (but not of Schultze).
= *Gastrophysema*, Haeckel.

The characters of Schultze's genus *Squamulina* are:—"Test like a plano-convex lens, with the flat side attached; calcareous; enclosing a simple undivided cavity ('eine einfache ungetheilte Höhlung umschliessend'); a large opening on the convex side; without small pores." Carter, in 1870, apparently had not Schultze's 'Ueber den Organismus der Polythalamien' at hand, and only knew that author's genus through Carpenter's 'Introduction.' It so happened that Carpenter omitted all reference to the "simple undivided cavity;" and thus Carter fell into the mistake of placing in *Squamulina* a form the foraminiferal nature of which he was attempting to establish on account of the *non-simple* and pseudo-septate character of the pedestal or plano-convex foot. Foraminifer or not, the pseudo-septate-based, arenaceous *Haliphysema Tumanowiczii*, with its great (great as compared with the plano-convex base) obversely conical column and body, has most certainly no near relation to the little scale-like, calcareous *Squamulina*, with its simple, little, dome-shaped undivided chamber. It is probable that Mr. Carter, with his present knowledge, would not now attempt to maintain that position; a much stronger argument might have been based on comparison with such a masonic foraminifer as *Lituola nautiloidea*, Lamk., which, commencing with a small spiral arrangement of cells, suddenly altering its growth, develops a straight series of chambers of great size as compared with those preceding.

Haeckel's views of nomenclature are peculiar to, and, it is to be hoped, always will remain peculiar to, himself. He appears to take pleasure in establishing spurious genera and subsequently demolishing them*. I am sorry to anticipate

* It is really much to be regretted that Haeckel, using the slightest modifications, or supposed possible modifications, of character, which no other naturalist has ever dreamt of regarding as of even varietal importance,

him with respect to *Gastrophysema*, and thus deprive him of the pleasure he experiences in the art of "happy despatch." I thoroughly indorse Mr. Kent's argument. I have several two-celled, and some three-celled, examples of true *Lagenæ* in my collection; are new genera to be created for them? A Greenland Nodosarian (*Dentalina pauperata*, Parker and Jones) has much more commonly one chamber only than two

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should manufacture, and often immediately afterwards proceed to destroy, innumerable genera and species. We already, without this sort of thing, have only too much useless synonymy. As an example of Haeckel's treatment of the calcareous sponges take our poor little friend *Grantia compressa*, a species which, until the advent of the Professor of Zoology at Jena, we all thought we knew. Behold the atlas which Haeckel has laid upon this miserable little creature's shoulders to bear—1. *Sycarium compressum*, 2. *Artynas compressus*, 3. *Sycidium compressum*, 4. *Artynium compressum*, 5. *Sycocystis compressa*, 6. *Artynella compressa*, 7. *Sycophyllum compressum*, 8. *Artynophyllum compressum*, 9. *Sycometra compressa*, 10. *Sycum lingua*, 11. *Sycarium rhopalodes*, 12. *Artynas rhopalodes*, 13. *Artynella rhopalodes*, 14. *Dyssycum clavigerum*, 15. *Sycophyllum lobatum*, 16. *Sycurus compressus*, 17. *Syconella compressa*, 18. *Sycothamnus compressus*, 19. *Sycinula compressa*, 20. *Sycodendron compressum*, 21. *Sycandra foliacea*, 22. *Sycandra pennigera*, 23. *Sycandra clavigera*, 24. *Sycandra rhopalodes*, 25. *Sycandra lobata*, 26. *Sycandra polymorpha*, 27. *Sycortis compressa*! The first fifteen of these names were established in the 'Prodromus eines Systems der Kalkschwamme;' but in his 'Die Kalkschwamme' he knocked upon the head eleven out of the fifteen generic names just before coined, but immediately proceeded to construct twelve more names to take their place. This done, he again bowls his nine-pins over, and leaves us with a twenty-eight-synonymed *Sycandra compressa*, which he would have us accept as the mother of all his stillborn children. I am sorry that we cannot even oblige him in that. *Grantia compressa* is the name under which our old lady was baptized; and that name has been, is, and will be the honoured name she loves to own; but if she changes her name at all, it must be to that of *Artynes*, of Gray, of which she is the type. But the Professor has not even yet done. At page 381 he favours us with "Zweite Abtheilung. Künstliches System der Kalkschwamme." "Kunstliches" indeed! Here we find I know not how many subgenera formed for the "generic varieties;" and the much-enduring *Grantia compressa* is made to undergo the further torture of having its *disjecta membra* thrown, in the form of six "subspecies," into each of the nine following new and euphonious "subgenera"—*Sycurandra*, *Syconellandra*, *Sycandrarium*, *Sycocystandra*, *Sycothamnella*, *Sycinulandra*, *Sycodenandrum*, *Sycandrophyllum*, *Sycandrometra*. The magician waves his wand: "Behold! *Grantia compressa* might be, can be, *is* divided into fifty-four (6×9) subspecies; and then do not forget my 'connexive Varietat,' which makes fifty-five. It is done! Veni, vidi, vici!!" We gladly leave with him the victory; but surely a man of Prof. Haeckel's genius might more worthily employ his time. Had his demonstration been that fifty-five forms which had been named and placed by other naturalists as so many species in twenty-seven genera, were nothing more than the unstable modifications of one type, and, as possessing no constant character, must be brought together in one so-called species, a benefit would have been conferred upon science.

or more; must a genus be created for this, to separate it from species which often have twenty and more chambers? Lists of such comparisons might be multiplied to any extent. *Gastrophysema* is simply *Haliphysema* more fully developed.

Haliphysema Tumanowiczii, Bow.

1862. *Halyphysema Tumanowiczii*, Bowerbank, Philos. Trans. p. 1105, pl. lxxiii. fig. 3; Monog. Brit. Sponges, vol. i. (1864) p. 179, pl. xxx. fig. 359, vol. ii. p. 76.
1866. *Halyphysema Tumanowiczii*, O. Schmidt, Zweites Supplem. d. Spong. d. Adriatischen Meeres, p. 13, plate, fig. 13 (copy from Bowerbank).
1868. *Halyphysema Tumanowiczii*, Parfitt, Trans. Devon Assoc. Sci. Literat. and Art, p. 14 (separate copy).
1870. *Squamulina scopula*, Carter, Ann. & Mag. Nat. Hist. ser. 4, vol. v. p. 310, pl. iv. figs. 1–11, and vol. xx. (1877) p. 337.
1877. *Haliphysema primordiale*, Haeckel, Biologische Studien, p. 180, pl. ix.
1877. *Haliphysema Tumanowiczii*, Haeckel, *l. c.* p. 192.
1877. *Gastrophysema dithalamium*, Haeckel, *l. c.* p. 196, pls. xii–xiv.
1877. *Gastrophysema scopula*, Haeckel, *l. c.* p. 206.

Hab. Hastings (*Mr. Tumanowicz*), Berwick Bay (*Dr. Johnston*), Cullercoats (?) (*Alder*), Budleigh-Salterton (*Carter*); Bergen, Norway (*Haeckel*); "*H. primordiale*," Mediterranean, Corsica (*Haeckel*); "*G. dithalamium*," Mediterranean, Smyrna (*Haeckel*).

Mr. Carter found this species at Budleigh-Salterton, and, though he renamed it, at the same time identified it with Bowerbank's type species of *Haliphysema*. Haeckel, however, denies that Carter had ever seen Bowerbank's species. Mr. Carter has replied that he has *now* had the opportunity of comparing his own specimens side by side with those of Dr. Bowerbank, and that they are identical. This last statement I am in a position to entirely indorse. In my collection are some of Mr. Tumanowicz's type specimens on *Halecium Beanii*, which were given to me by Dr. Bowerbank, and also type specimens of *Squamulina scopula*, for which I am indebted to Mr. Carter. They are *absolutely identical*. I have not seen any specimens with the constrictions so deep and strongly marked as Carter's pl. iv. fig. 2; but the largest of Mr. Tumanowicz's examples closely resembles his chief figure (3), while the youngest resemble the typical figures of *Tumanowiczii*, and *primordiale* and those of intermediate age, *dithalamium*; at the same time monothalamous specimens often exceed in size the dithalamous. They range from 1 to 2 millims. in length.

Haeckel's characters for his so-called species are:—

H. primordiale. "Body of person spindle-shaped, attached

by a short thick pedicel. Pedicel solid, cylindrical, scarcely half as long as body. Body-cavity spindle-shaped. Mouth-opening simple. The extraneous bodies which incrust the exoderm consisting on the lower (aboral) half chiefly of sand-grains, on the upper (oral) half by preference of spicules of different sponges, both siliceous and calcareous, spicules arranged oralwards."

G. dithalamium. "Body of person, taken as a whole, long and club-shaped, divided by a median constriction into two chambers lying one over the other; attached by means of a short cylindrical pedicel. Pedicel placed upon a disk-shaped widening base. At the opposite (upper) end a simple, circular mouth-opening. The uppermost (distal or oral) chamber elliptical or egg-shaped, one third larger each way than the under round chamber. Pedicel and foot-disk solid. The cavities of the chambers joined by a narrow neck (sipho). In the aboral chamber (*Bruthöhle*) the ova are developed. A ciliated spiral is found in the oral chamber near the mouth-opening. Extraneous bodies which incrust the exoderm composed on the under half, for the most part, of sand-grains and fragments of spicula; on the upper half (in the wall of the second or largest chamber), of long spicula of different species of sponges; these stand out on all sides, and have their points directed forwards."

I cannot think that the fact of the pedicel in the forms described by Haeckel being characterized as solid, while in those examined by Carter it is hollow, is of any consequence. Carter's observations were quite correct as regards dead specimens; but he himself, in cutting a living *H. ramulosum* across the pedicel, observed the escape of the sarcode or syncytium with which it was filled; and I take it that all that Haeckel means, and all that he figures, is that the pedicel is filled with such syncytium, whereas the chambers have a hollow cavity. In drying, the syncytium, shrinking up against the pseudoskeleton of the surrounding wall, leaves the pedicel, as observed by Carter, hollow; and the cavity of the body will, in that condition, extend from the mouth-opening to the plano-convex disk of attachment.

I have given Haeckel's characters of *primordiale* and *dithalamium*, which will speak for themselves. Without further evidence these scarcely appear to be of specific or even varietal importance.

2. *Haliphysema ramulosum*, Bow.

1866. *Halyphysema ramulosa*, Bowerbank, Monog. Brit. Sponges, vol. ii. p. 79, and vol. iii. (1874) pl. xiii. fig. 1.

1870. *Halyphysema ramulosa*, Carter, Ann. & Mag. Nat. Hist. ser. 4, vol. v. p. 389. *Squamulina scopula*, var. *ramulosa*, id. ibid. vol. vi. p. 345.

1877. *Haliphysema ramulosum*, Haeckel, Biologische Studien, p. 193.

Hab. Dredged off Guernsey on *Gorgonia verrucosa*, and in Birterbuy Bay, Ireland, on *Phyllophora rubens* (*A. M. N.*); among sponges and on rocks between tide-marks, Budleigh-Salterton, Devon (*Carter*); off the coast of Florida, U. S., dredged by Pourtales, *fide* Schmidt (*Carter*).

I regard this as entirely distinct from *H. Tumanowiczii*; indeed the differences are so important that it is probable they will hereafter be regarded as generic.

In *H. Tumanowiczii*, with the development of the animal, a series of incompletely separated chambers is formed by greater or less *transverse* constrictions of the test.

In *H. ramulosum*, with the development of the animal, a series of completely separated chambers is formed by *longitudinal* fission and entire partition of the last-formed chamber; and this process, continually repeated, issues in the building up of a colony consisting of a many-branched head surmounting a long pedicel, the branches dichotomously divided with great regularity, and each terminating in a rather small rounded chamber.

A single head of either, however, may be distinguished at a glance, apart from the mode of growth; or they may again be separated in the early stages when only a single chamber is developed, since in *H. Tumanowiczii* that chamber is more or less elongate-ovate, and has the points of its garnishing spicula all directed forwards; but in *H. ramulosum* it is round or subrotund, and has its garnishing spicula radiating in every direction.

In 1874 I procured in Birterbuy Bay a piece of *Phyllophora rubens* covered with the young of this species in their early unbranched condition with only a single head; from their young state they were very fragile, and the greater number in drying separated from their bases. But the *Phyllophora* was sent for Dr. Bowerbank to see; and among his unpublished manuscript I find the following note:—"Among the specimens I received from the Rev. A. M. Norman for examination there was a portion of a thin foliaceous *Fucus*, rather exceeding two inches in length and three in width, both surfaces of which were nearly covered by small patches of various species of *Lepralia*, small shells, and other parasites; and amid these, based on the *Fucus*, there were numerous young specimens of *Halyphysema ramulosa*. They consisted of single tubes of the sponge, very rarely exhibiting

any rudiment of terminal branches, each springing from a small circular basal patch. Although in so young a condition, they were identical in structure with the type specimen represented in pl. xiii. fig. 1, vol. iii., Mon. Brit. Spongiadæ." I quote this as confirming my own opinion respecting the unbranched young of *H. ramulosum*.

On the other hand, the largest specimen I have seen is one for which I am indebted to Mr. Carter, who found it at Budleigh-Salterton. It is 7 millims. high, of which 5 millims. is occupied by the slender unbranched stem, nearly another millim. is taken up by the first fork; and in the last millim. of length the branches divide and subdivide, extending themselves in all directions, and terminating ultimately in sixteen branchlets with their terminal heads.

3. *Haliphysema echinoides*, Haeckel.

1877. *Haliphysema echinoides*, Haeckel, Biologische Studien, p. 180, pl. x.

"Body of person round or subspherical, attached by a long and slender pedicel. Pedicel cylindrical, conically widened above, solid, 2–3 times as long, but scarcely ¼ as wide as the diameter of the ball. Body-cavity round or subconical. Mouth-opening widening into a somewhat funnel-shaped form. Extraneous bodies, which incrust the exoderm of the pedicel, consisting of sand-grains and longitudinally arranged sponge-spicules; extraneous material of the ball-shaped body consisting of spicules of various sponges, which stand out on all sides, chiefly, however, radiating from and covering the middle of the body" (*Haeckel*).

There is but little in the above description to distinguish this from the last-described species, to the young unbranched stage of which it bears a very close resemblance. I, however, keep it apart, because the ball is represented as much larger in proportion to the pedicel than I have ever seen it to be in *H. ramulosum*; and the character of the spicules employed seems to show that it is a deep-sea species, whereas *H. ramulosum* lives in shallow water. When Haeckel's species is better known, it may prove to be more distinct than it now appears. Moreover the large size of the ball, as compared with the axial column, will be seen to present difficulties in the way of the longitudinal fission of the heads and their conversion into branches, which I regard as so important a feature in the evolution of the colony of *H. ramulosum*.

Hab. Atlantic Ocean (*Koren* fide *Haeckel*).

It is surprising that Haeckel should have thought that there was any relation between the animal he described as

above and *Wyvilletomsonia Wallichii*, P. Wright. The apparent resemblance is a mere matter of isomorphism. Any spongologist looking at Stewart's beautiful figure illustrating Wright's paper will at once see that he has a sponge before him, that the spicula are in natural position in the tissues, and the whole spicules are those of *Tisiphonia agariciformis*, Wyv. Thomson, of which I agree with Mr. Carter in considering Wright's little sponge to be the young stage. The aspect of *H. echinoides* is wholly different; the spicules are stuck into the tissues as adornments or objects of defence, and clearly have just as much connexion with the animal that wears them as the upstanding feathers of the head-dress of a Red Indian have with the man who puts them on. It is true that *H. echinoides* has appropriated, for the most part, the spicula of *Wyvilletomsonia* or of some closely allied corticate sponge; but mixed with these are the spheroids of a *Geodia*, together with some recurvo-ternates, which, from the robust character of their prongs, also seem referable to the latter genus.

4. *Haliphysema globigerina*, Haeckel.

1877. *Haliphysema globigerina*, Haeckel, Biologische Studien, p. 189, pl. xi.

"Body of person pear-shaped, attached by a very slender and long pedicel. Pedicel solid, cylindrical, conically widened above, about 4–6 times as long, but scarcely one tenth as wide as body. Body-cavity pear-shaped. Mouth-opening simple. Extraneous bodies, which incrust the exoderm, composed of the elements of deep-sea mud, consisting in the body-wall chiefly of Rhizopod shells, in the pedicel chiefly of coccoliths and coccospheres."

Hab. "North Atlantic Ocean (*Randropp*)" (*Haeckel*).

The above species differs entirely from the rest in its selection of shells of Foraminifera, Polycystina, Coccoliths, and Coccospheres as the strengthening material of its body-wall, which exhibits, on the other hand, a total absence of sponge-spicules.

I am strongly reminded by this species of an approaching isomorph found in deep water in the Atlantic, and which Mr. H. B. Brady proposes to describe under the name "*Hyperammina*," on account of its pestle-like form. There can, however, I think, be no doubt that *Hyperammina* is a foraminifer. The expanded extremity has no mouth-opening; and the colour of the walls, which consist entirely of sand-grains, is, as in many other arenaceous Foraminifera, ferruginous.

5. *Haliphysema confertum*, n. sp. (Pl. XVI. figs. 1, 2.)

Animal consisting of a bunch of "persons" attached together by their bases, and forming nearly a complete ball. Body of person nearly spherical, attached by a long slender pedicel. Pedicel 3–4 times as long, and not more than one fourth as broad, as the body. Mouth-opening very large. Extraneous bodies, which incrust the animal, consisting, on the pedicel, of sand-grains and other very minute bodies; on the body, of sand-grains and Foraminifera.

Diameter of a cluster, containing forty or fifty "persons," about one millim.; length of a "person" about one third of a millim.

Hab. 'Valorous' Expedition, 1875, Station No. 9, lat. 59° 10′ N., long. 50° 25′ W., 1750 fathoms. The position of this dredging is just within Davis Strait.

Two clusters of the above organism were found; the one had all the bodies broken off, and consisted of a nearly globular aggregation of the pedicels; the other had several of the bodies still remaining. It is not without doubt that I place this organism in the genus *Haliphysema*, because the extraneous material is not apparently completely built into the substance of the body-wall, but appears rather as though clinging to a viscid substance which holds it. The fact, however, that in the pedicels the extraneous bodies are all of very minute size, whereas on the exterior of the round body-cavity an occasional minute *Globigerina* is found to have a place, seems to argue a selection on the part of the animal; and I know of know other order to which these animals can be referred.

III. *On two new Genera perhaps allied to* Haliphysema.

Genus Technitella, n. g.

(τεχνίτης, an artificer.)

Test elliptical, cylindrical, or subfusiform, composed of the broken fragments of sponge-spicula arranged parallel to the axis and enclosed entirely, or rarely only partially, in the body-wall. Unattached below and closed. A tubular mouth-opening formed by a contraction for a short distance of the body-walls so as to form a short tube.

Technitella legumen, n. sp. (Pl. XVI. figs. 3, 4.)

The form of the test in this animal reminds one somewhat of the outline of the pod of the edible pea, being cylindrical throughout the greater part of its length, with the aboral

extremity slightly extruded, and that rather out of the central line, as is the distal point (style) of the pea-pod, while the mouth-opening is in the form of a contracted tube, representing about the same proportional length and width to the cylinder as the basal portion of the pea-pod, where it passes into the calyx, does to the pod itself.

The body-wall of *Technitella* is an exquisite specimen of perfect masonry: it is beautifully built up of the fragments of minute acerate spicula, laid in regular order side by side, and cemented with a mortar composed probably of the finest dust of quartz, so that the whole test is of exquisite snowy whiteness, corresponding in this respect to that of *H. Tumanowiczii*. Length 1·25 millim.

Hab. Found among rich foraminiferous sand dredged by Dr. Jeffreys's yacht 'The Osprey,' in 112 fathoms, 30 miles west of Valentia, Ireland, in 1870.

Technitella melo, n. sp. (Pl. XVI. figs. 5, 6.)

Test regularly ovoid, broadly and evenly rounded below (aborally); greatest diameter below the middle; above the middle sloped away to the central anterior (oral) opening. Oral opening not markedly extruded or tubular as in the last species, but compressed, so that the opening is in the form of a slit; this slit in the type is wider at the sides than in its central portion. The test is formed of minute linear sponge-spicules, built carefully into the wall, and the interstices filled with the same sort of snow-white cement as in the last species. Instead, however, of the whole of the spicula being entirely built into the body-wall as is the case in *Technitella legumen*, in this species the aboral portion is garnished with scattered acerate projecting spicula, the pointed ends of which are protruded considerably from the body-wall, and are invariably directed backwards. Length 1·4 millim., breadth 1 millim.

Hab. Found among material dredged about 60 miles south of Rockal, by the 'Porcupine' Expedition, in 1869. Station No. 28, lat. 56° 44′ N., long. 12° 52′ W., 1215 fathoms.

The form of this little animal is just that of such a *Lagena* as *L. melo*, D'Orb.; and its aspect under a high power, with its imbedded and here and there projecting little spicula, reminded me forcibly of the appearance of a cocoa-nut when the outer husk is stripped off.

The type was picked out from the 'Porcupine' material by Mr. H. B. Brady, and sent to me marked "sponge?" There is no higher authority among the Foraminifera than Mr. Brady; and it is important therefore, as bearing upon the position which I have provisionally assigned to this genus, that

he has rejected it from among the Foraminifera, on the description of which he was engaged.

Genus Marsipella, n. g.

(*μάρσιππος*, a purse.)

Test elongated, fusiform, centrally cylindrical, and drawn out to gradually attenuated extremities, open at both ends, monothalamous; anterior extremity much produced into a narrow contracted mouth-opening. Extraneous matter of body-wall consisting for the most part of sand-grains, but at the oral extremity composed almost solely of fragments of sponge-spicula longitudinally arranged.

Marsipella elongata, n. sp. (Pl. XVI. fig. 7.)

1875. *Proteonina* ——, Carpenter, The Microscope, p. 533, woodcut, *d, e, f*.

Test greatly elongated, the diameter equal to one seventh to one twelfth of length, gradually drawn out to the extremities, and nearly equally so orally and aborally. Oral extremity in the form of an elongated narrow mouth-opening. Test built up of coarse sand-grains roughly put together, interspersed here and there with a sponge-spicule. Tubular mouth-opening having its wall entirely formed by a faggot of acerate sponge-spicula longitudinally disposed and cemented together. Length 4–5 millims.

Hab. 'Porcupine' Expedition, 1869, No. 87, lat. 59° 35′ N., long. 9° 11′ W., 767 fathoms.

Dr. Carpenter has referred the foregoing to the genus *Proteonina* of Williamson; but that genus appears to have been founded upon imperfect specimens of *Lituola nautiloidea*, Lamk., and its connexion with the present species cannot be maintained.

I have introduced the descriptions of the genera *Technitella* and *Marsipella*—not that I am at all satisfied that their organization will ultimately prove such as to cause them to be left in juxtaposition with *Haliphysema*, but because they appear to me to be *genera incertæ sedis*, to which it appears desirable to call attention in connexion with *Haliphysema*. From this genus it will be obvious that they are at once to be distinguished by their free and unattached character; but there is much in the form of their body-cavity, as well as in the structure of their masonic walls and the peculiar way in which the incorporation of the sponge-spicules takes place, which suggests possible relationship. The snowy whiteness of the test of *Technitella* is, as far as I am aware, without

parallel among the arenaceous Foraminifera, while it is eminently characteristic of *Haliphysema*. *Marsipella* is described as unattached and open on the aboral extremity; for such is the condition of the specimens which I have seen; but it is possible that when living it may be attached by the base, since, if this were the case, it is hardly likely that such a little organism would maintain its attachment after the rough treatment of being dredged and drawn up through two miles of water.

Though these two forms appear to have so much in common with *Haliphysema* as regards external features, yet the deep Atlantic dredgings of the 'Porcupine' and 'Valorous' have brought to light such a remarkable assemblage of arenaceous Foraminifera, most of which are still undescribed, that it appears impossible to say where the line of demarcation is to be drawn between *Technitella* and *Marsipella* and such genera as *Trochammina* and *Lituola*. Future investigation can alone settle this point. Meanwhile I describe them here as appearing to me more nearly related to *Haliphysema*, though still I leave them as *genera incertæ sedis*.

POSTSCRIPT.

The foregoing paper was sent to the Editors of the 'Annals' at the end of January. Mr. Carter's notes in the February number call for one or two additional observations.

Mr. Carter makes the following remarkable declaration:—"Whether there be collared flagellated monadic bodies in *Squamulina scopula* or not, the polythalamous character, so appropriately given by the illustrious Ehrenberg to what we now call Foraminifera, decides the question with those who are well acquainted with the structure of the latter as well as that of the Spongida. No sponge, that I know of, presents the polythalamous character of *Squamulina scopula*, in its foot (root) or anywhere else."

I must decline to acquiesce in such a statement.

First. Because I deny that there is any "polythalamous" character in the base of *Haliphysema*; and I believe that this is the first time that Mr. Carter has made such a statement. He has before always correctly spoken of this dome-shaped base of attachment as internally "*partially* divided," "*pseudo*-septal," "*sub*-polythalamous." There really is but a single chamber, with recesses at the sides formed by the 5–7 radii, which, originating at the margin, stretch thence "toward the centre, which they seldom, if ever, reach." To compare great things with small, the single-chambered dome of the Reading-

Room of the British Museum with its radiating desks (supposing them carried up to the roof) will be analogous to what we have in the dome-shaped base of *Haliphysema*, while the long series of Libraries connected with each other only by doors represents the typical polythalamous character of the Foraminifera.

Secondly. Are we really to understand Mr. Carter to mean that if his own examination of living *Haliphysema* should confirm Haeckel's discovery of the existence of "collared, flagellated monadic bodies," or, as Carter has elsewhere named them, "spongozoa," he will still maintain that the organism furnished with these *spongozoa* is a Foraminifer? All I can say is that I should await with interest the arguments by which he would maintain such a view.

Further on Mr. Carter states that Schmidt (Archiv f. mikroskop. Anat. Bd. xiv. p. 260) has referred *Haliphysema echinoides*, Haeckel, to the genus *Stelletta*. I have not seen this paper of Schmidt. It is hardly conceivable that that eminent spongologist can have come to such a conclusion from the examination of Haeckel's figure and description; for if tab. x. represents accurately the type *, it appears to me as impossible to suppose that the spicules drawn belong to the sponge and are in natural position, as it is to suppose (as Haeckel wrongly imagined) that the spicula in Perceval Wright's admirable illustration of *Wyvilletomsonia* are not in their natural position †. It may be that Schmidt has examined the type specimen, that the drawing is wrong, and that on this ground he asserts that Haeckel's species is a *Stelletta*. If that bé so, *cadat quæstio*.

Lastly, I do not understand what Mr. Carter means when, in reference to the form of the dome-shaped base of *Haliphysema*, he contrasts with it the "embryo of the Spongida," which "grows up into branches from a *root*." Barrois ‡ has represented the early canal-system (pl. xv. fig. 35) in the young of *Halisarca lobularis*, Schmidt, just passing from the

* Unfortunately we are never sure when looking at Haeckel's beautiful plates whether we have before us what the draftsman actually saw, or whether the figure is a representation of what he thought he ought to see, and which his theorizing led him to the conclusion should be seen.

† I have many specimens of *Wyvilletomsonia Wallichii*, P. Wright (= *Tisiphonia agariciformis*, Wyv.-Tom., = *Dorvillia agariciformis*, Kent), as small as that represented in the type, and one specimen not one fourth of that size; and it is from the examination of these specimens that I state positively that Wright and Carter have correctly regarded it as a corticate sponge.

‡ Barrois (C.), "Mémoire sur l'Embryologie de quelques Eponges de la Manche," Annales des Sci. Natur. vi^e sér. Zoologie, tom. iii. 1876.

embryo stage; and the form of that incipient canal-system is remarkably like the chamber left in the semiseptate dome at the base of *Haliphysema*. I may add, when referring to Barrois, that at pl. xiii. fig. 15 he gives a capital illustration of pseudopodial action in the young of *Grantia compressa*—an additional witness to what I have stated in the earlier part of this paper, that the protrusion of pseudopodial processes in *Haliphysema* is no proof whatever that it is not a sponge.

EXPLANATION OF PLATE XVI.

Fig. 1. *Haliphysema confertum*, Norman, × 40.
Fig. 2. *Haliphysema confertum*, Norman, a single individual separated from the group, × 150.
Fig. 3. *Technitella legumen*, Norman, × 40.
Fig. 4. *Technitella legumen*, Norman, anterior portion, × 40.
Fig. 5. *Technitella melo*, Norman, × 100.
Fig. 6. *Technitella melo*, Norman, posterior portion, × 40.
Fig. 7. *Marsipella elongata*, Norman, × 100.

XXXI.—*On the Architectural Achievements of little Masons, Annelidan (?) and Rhizopodan, in the Abyss of the Atlantic.* By the Rev. A. M. Norman, M.A.

No group of Invertebrata has received more important additions through the recent dredgings in the North Atlantic than the Arenaceous Foraminifera. The mode of incorporation of extraneous material in the tests of these and of other Rhizopoda, and also in the tubes of what are presumed to be cases of minute Annelids, is not only marvellously beautiful, but appears also to be almost endlessly diversified. The power of selection evidenced is truly wonderful: from the same ground, and therefore from the midst of the same material for use, I have seen as many as seventeen different species, each of which has a specific individuality of its own in the choice and mode of appropriation of the particles, whether of mineral or organic origin, which it selects from the mud—and this wholly apart from characters which depend on the form of the one or more chambers which constitute the animal or tube. To exemplify my meaning I will throw the classes of diversity into tabular form, so as to give some slight idea of the varied ways in which these clever little artificers set about their work and construct their dwellings.

A. *Material chosen by the Artificers.*

1. Coarse sand-grains, almost entirely of quartz.
2. Medium-sized quartz-grains.

3. Comminuted dust of quartz.

The above workers, though living together and, so to speak, getting their material from the same quarry, are most particular as to the size of the stones they respectively build with.

4. Various grains of different colours, many black (apparently manganese), giving the whole test a grey colour*.
5. Sponge-spicules, rarely of any other form than accrates; but while one (A) will select only fragments of large acerates, another (B) will reject every thing save the smallest spicules.
6. *Globigerina*-shells used exclusively.
7. Test made of sand-grains of small size, with here and there a *Globigerina* stuck in a conspicuous manner on the outside, as though for ornament.
8. Tests formed of the minutest particles of "*Globigerina*-ooze," consisting of coccoliths &c.
9. Tests in which flat fragments of the shells of bivalve Mollusca form conspicuous objects; the fragments may be so built together as to form (A) a produced series of chambers (after the form of *Valvulina gramen*, D'Orb.), or (B) a flattened disk, as, for example, *Astrorhiza limicola*, Sandahl.

So much for the material employed; but there are also various ways of working up the objects into the structures. Here are some:—

B. *Modes of using the Building-material.*

1. A promiscuous mixture of little pebbles of various kinds, of larger *Globigerinæ* and other Foraminifera. This is, perhaps, the least-interesting builder (see "coarse type of Nodosarine *Lituola*," Carpenter, Microscope, p. 531, fig. 271, *e*).
2. The selected quartz-grains (whether 1, 2, or 3 of last list) may be used in various ways—either roughly cemented together, with their angles projecting, as in a "rough-cast" wall: of this mode of building, *Botellina*, *Rhabdammina abyssorum*, Sars, *Storthosphæra albida*, Schultze, and some microscopic (annelid ?) tubes are examples. Or,
3. They may build with most wonderful exactness, each grain fitted carefully into the interstices of its neighbours, so that there is hardly any space left to be filled up by the

* This is the species which has just been recorded by Mr. H. B. Brady under the name *Spiroloculina celata*, Costa, in a paper "On the Occurrence of Chalk in the New-Britain Group," Geol. Mag. dec. ii. vol. iv. no. 12, Dec. 1877, p. 7 (separate copy).

cement-mortar, the mode of building reminding us of the careful dovetailing and fitting of the stones in a Cyclopean wall: of this mode of building, a *Difflugia* (?) from Davis Strait affords a type. Or,

4. The material may be so built as to present a tolerably even smooth surface, although the faces of the grains are still exposed, as in the "Globigerine," "Nodosarine," and "Orbuline *Lituola*," figured by Carpenter 'Microscope,' p. 533, fig. 273, *a*, *b*, *c*, *g*, *h*. Or,
5. The sand-grains may be entirely plastered over and covered by the sarcode-cement, so that the surface is smooth and polished, like the face of a wall built of rubble imbedded in cement: of this, *Cyclammina cancellata*, H. B. Brady, MS., and some other beautiful undescribed forms are examples.
6. So with the employment of sponge-spicules. Nothing but fragments of large spicules may be employed: and these may be (A) laid longitudinally and cemented into a rough tube, or (B) they may be used only in one particular part of the structure, as in *Marsipella elongata*, Norman. Or,
7. Nothing but the smallest spicules may be used, and these incorporated with great exactitude in the walls, none of them projecting to the smallest degree, as in *Technitella legumen*, Norman, and an undescribed tube. Or,
8. They may be projected at right angles to the surface, standing out hedgehog-fashion from the wall, as in *Pilulina Jeffreysii*, Carpenter, and in some beautiful tubes in my collection. Or,
9. A spicule may stand out here and there from a wall which is mainly built up of very finely comminuted material, as in Carpenter's "moniliform *Lituola*" (*l. c.* fig. 271, *f*) and in another species in my collection. Or,
10. A single large spicule may be employed to form an axis, on the middle of which a little sand ball is wrapped, so that it has the appearance of being spitted by the spicule, which projects many times the length of the ball on each side of it.
11. The Globigerine shells, to the exclusion of every thing else, are built up into a form closely related to *Lituola scorpiurus* (Montfort).

C. *Colour of Deep-sea Arenaceous Foraminifera.*

1. White: *Technitella legumen*, Norman, *T. melo*, Norman, or the *Globigerina*-building form just referred to.

2. Dirty brown (sand-colour, as we ordinarily term it): *Astrorhiza arenaria*, Norman, or "Orthocerine *Lituola*" of Carpenter.
3. Rust-coloured or ferruginous, the tint (*a*) dark: *Cyclammina cancellata*, Brady, MS. (*b*) rich and ruddy: *Trochammina irregularis*, the tadpole-shaped form figured, Carpenter, Introd. Foram. pl. xi. fig. 6; *Trochammina gordialis*, P. & J.; and *Astrorhiza catenata*, Norman. (*c*) pale: *Lituola canariensis*, D'Orb., and the forms mentioned under B.
4. Grey: see A, 4.
5. Very dark, almost black, as in an abyssal Foraminifer which seems to be identical with the fossil *Nodosaria Schlichtii*, Reuss.
6. Green: the green sarcode in *living* specimens is often very vivid. I have an undescribed scale-like form which has been dead eleven years; yet on being wetted the green colouring is most conspicuous.

The above brief notes will give some notion of the wonderful skill displayed by these little architects. I have made no allusion to the very great variety of form in their dwellings; and inasmuch as the greater number of the species from which these Notes are drawn remain still undescribed, I have only been able to illustrate my meaning by reference to a few named species. Brief as the Notes are, I have thought that they would have interest at the present moment as connected with structures built by *Haliphysema*, *Technitella*, and *Marsipella*.

XXXII.—*Descriptions of new Species of Heterocera from Japan.*—Part II. *Noctuites.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

[Continued from p. 204.]

Amphipyridæ.

134. *Amphipyra erebina*, n. sp.

Allied to *A. perflua*, but rather smaller, more sericeous; the primaries with the inner zigzag stripe obscured, the outer stripe less white and not so regularly dentate-sinuate, the external area greyer, with the markings less distinct; a blackish lunate subapical patch: secondaries dark grey instead of pale brown; fringe and marginal edge sordid whitish. Wings below streaked with grey, the discal band darker and more sharply

defined; the discocellular spot of primaries dark brown, ill-defined, that of secondaries black; a broad submarginal greyish-brown band diffused internally on the primaries. Expanse 2 inches 1 line.

Yokohama (*Jonas*).

We have also a dwarfed example from Hakodaté measuring only 1 inch 9 lines in expanse.

135. *Amphipyra tripartita*, n. sp.

Intermediate between the *A. perflua* and *A. livida* groups. Primaries above glossy raven-black, crossed by two white belts, one near the base, the other running from the apical third of the costa to the external angle, slightly arched and partly intersected externally by a tapering dull red streak; area beyond the band brownish, with an irregular submarginal series of white-speckled black spots: secondaries shining chocolate-brown; fringe pale brown, with a broad central grey belt: thorax raven-black; abdomen smoky brown, with a shining greenish lustre. Underside greyish fuliginous, sericeous; the external area broadly darker, crossed by a paler discal band; secondaries with the costal half dusky, base whitish; a black spot at the end of the cell; legs black, banded with whitish. Expanse 1 inch 11 lines to 2 inches 4 lines.

Yokohama (*Jonas*).

136. *Orthogonia crispina*, n. sp.

Primaries above pale greyish whity brown (in some examples purplish brown and sericeous, with the exception of the internal border), tinted here and there with green, and striated with grey; a triangular dull greenish spot at the base of the cell, bounded above by a λ-shaped black marking and below by a black γ; base brownish, a large black spot near the base of inner border; a broad central brown band, tinted with lilacine and green, clouded and striated with black, its inner edge angular, its outer edge gently bisinuate, both edges immediately followed by a grey line of the same form; costal margin yellow, spotted with blackish from the end of the cell, a greyish discal streak in which (on the discoidal interspaces) are two black spots; a broad external tapering greyish patch, bounded internally by a darker line and, opposite to the discal spots, by a black ➤; a marginal row of black lunules; fringe purplish brown, with a yellow undulated basal line: secondaries greyish brown, with broad diffused purplish brown outer border; costal area silky opaline whitish; fringe testaceous, tipped with white: body corresponding in tint with

the wings; the thorax greyish whity brown in the centre. Wings below pale shining brown, a discal line and a diffused belt beyond it greyish; fringe as above: costa of primaries yellowish; a brown discocellular lunule in secondaries. Expanse 2 inches 6 lines.

Yokohama (*Jonas*).

Allied to *O. sera* of Felder.

137. *Mormo mucivirens*, n. sp.

Primaries above dull olive-green, with darker markings, nearly as in *Mormo maura*, edged with pale green; the pale brown diffused areas of *M. maura* replaced by sericeous grey more or less mottled with olive-green: secondaries purplish brown, the external area broadly darker; fringe testaceous, intersected by a grey stripe: body corresponding with the wings. Under surface fuliginous brown; primaries sericeous, especially towards the inner margin, which is greyish; two dusky parallel discal stripes; outer border rather paler than the rest of the wing; costa spotted with testaceous beyond the cell; fringe with a testaceous basal line: secondaries with a large spot at the end of the cell and a discal stripe blackish brown; external area dusky; fringe as above: legs blackish, speckled and banded with testaceous. Expanse 2 inches 6–7 lines.

Yokohama (*Jonas*).

PERINÆNIA, n. gen.

Nearly allied to *Nænia*, agreeing with it in the normal or three-branched median vein of secondaries*, but differing in its very broad compressed palpi, the terminal joint of which is at least twice as broad and abruptly truncated. Type *P. lignosa*.

138. *Perinænia lignosa*, n. sp.

Above shining fuliginous brown; primaries reticulated with paler brown; a longitudinal black streak through the cell, interrupted by white dots indicating the position of the orbicular and reniform spots, and terminating as it reaches a transverse undulated discal black line, beyond which are four or five decreasing black longitudinal dashes; a marginal series of black dots; fringe greyish, with a basal undulated testaceous line: secondaries with a broad blackish border; fringe whitish: abdomen greyish. Wings below whity brown, with diffused and blurred blackish discal line and black disco-

* It is placed among the "Quadrifidæ" because this vein *ought* to have four branches in all genera of that group.

cellular spots; discoidal cell of primaries greyish; margin and marginal dots black. Expanse 1 inch 10 lines.

Yokohama (*Jonas*).

139. *Nœnia muscosa*, n. sp.

Primaries sericeous greyish brown, with darker and paler markings much as in *N. typica*, but with the orbicular and reniform spots, a spot at the base, another near the base on interno-median area, and one near external angle pale greenish; the inner geminate line much more undulated, the submarginal black-bordered whitish line strongly dentate, the centre forming two ≶-shaped characters: secondaries sericeous grey, with darker central line and outer border; fringe as in *N. typica*: thorax pale testaceous, the collar sordid whitish at the base on each side, and surrounded by semicircular blackish lines; abdomen greyish. Wings below pale sericeous whity brown, the disk greyish; two dark grey discal lines; marginal black lituræ; fringe with an interrupted central grey stripe; secondaries whitish at the base; a blackish spot at the end of the cell. Expanse 1 inch 8 lines.

Yokohama (*Jonas*).

Toxocampidæ.

140. *Toxocampa lilacina*, n. sp.

Allied to *T. viciæ*, but the primaries distinctly shot with lilac; the spot at the end of the cell subtriangular, excavated in front, without the upper black dots; the discal belt with its inner pale margin much more deeply sinuated, and its outer pale edge rather straighter; this belt and the external area greyish brown: secondaries greyer, with broader and more uniform fringe: body greyer, collar and crest of head jet-black. Under surface greyer, the discal belt more diffused; tarsi of anterior legs with the terminal joints black. Expanse 1 inch 7–10 lines.

Yokohama (*Jonas*).

141. *Toxocampa enormis*, n. sp.

Primaries grey, with a slightly lilacine tint, crossed by five lines, the first basicostal, abbreviated, little more than an elongated brown spot, second straight, with a short angle above the costal vein, third regularly zigzag, bifurcate from the end of the cell (but interrupted by the reniform spot, which is black with brown centre and white margin), these three lines brown, indistinctly bordered with pale grey internally; fourth or inner discal line whitish, zigzag, lunulated from the middle

downwards; the wing beyond this line and the costal area as far as the third line suffused with brown; fifth line whitish and nearly straight to the first median branch, where it is replaced by a dark grey 3-shaped line; a submarginal series of short longitudinal whitish lines terminating in black dots; fringe dark grey, traversed by a whitish line: secondaries pale brown, with a broad fuliginous outer border; fringe stramineous: thorax grey, black-speckled, crest of head and collar jet-black; abdomen greyish, with the base and edges of the segments whitish; anal tuft stramineous. Under surface pale sandy yellow: wings with a broad blackish externo-discal band, outer border brownish, widest in primaries; fringe of these wings dark grey, with basal whitish line, discoidal cell and interno-median area greyish: secondaries with a grey dot at the end of the cell; front of pectus and legs above greyish. Expanse 2 inches 6 lines.

Yokohama (*Jonas*).

Of more than twice the bulk of any known species.

Ommatophoridæ.

142. *Nyctipao lætitia*, n. sp.

Near to *N. crepuscularis*, but altogether duller; the white discal stripe not bordered with lilac; the yellowish outer border of the arched white stripe and the diffused oblique bars on the external area replaced by dull pale brown; all the dark areas fuliginous; the ocellus smaller, its front margin more regularly convex; the white lunules on the disk of all the wings more slender, and enclosing large blackish spots. Under surface darker and duller, the white spots of the discal series rather larger, and the other spots smaller; the inner arched streak of secondaries further from the discal series of spots. Expanse 4 inches 5 lines.

Hakodaté (*Whitely*); Yokohama (*Jonas*).

Hypopyridæ.

143. *Spirama interlineata*, n. sp.

Spiramia (sic) *japonica*, Walker (nec Guénée), Lep. Het. Suppl. iii. p. 948 (1865).

♂, Yokohama (*Jonas*); ♀, Japan (*Fortune*).

S. interlineata chiefly differs from the *S. rectifasciata* of Ménétriés, of which we also possess both sexes, in the creamy tint of the white belt, which in the primaries is traversed by two parallel brown lines.

144. *Hypopyra Martha*, n. sp.

Nearest to *H. dulcina* of Felder, but at once distinguishable by its shorter primaries, its paler and redder coloration above, the absence of the oblique streak from the apex of primaries, the well-defined central belt formed by the central incurved grey line, and the series of black dots which in *H. dulcina* touch the pale undulated discal stripe, the latter placed near the submarginal line, which is strongly undulated; only two small black dots at the end of the cell; the transverse stripes of secondaries straight; body much as in *H. dulcina*, but the thorax darker and the collar redder. Under surface quite different, uniformly red, crossed by three equidistant dusky discal stripes; veins, base, and a submarginal series of <-like marks brownish. Expanse 3 inches 1 line.

Yokohama (*Jonas*).

Ophiusidæ.

CHRYSORITHRUM, n. gen.

Allied to *Ophiusa* (*O. fulvotænia*), but differing in having the terminal joint of the palpi twice the length, the tegulæ greatly developed laterally so as to form a roof-shaped crest over the back of the thorax, the secondaries without the angle at the end of the first median branch. Type "*Catocala amata*" of Bremer.

145. *Chrysorithrum sericeum*, n. sp.

Smaller than *C. amata*; primaries shining slaty grey, all the markings black, and surrounded by a line of the ground-colour, followed by a black line; the angular subbasal band of *C. amata* replaced by a very irregular band, not reaching the inner margin, its outer and inferior borders forming three undulations, its inner edge Σ-shaped: secondaries fuliginous brown, the disk deepest in colour, a broad tapering ochreous band, not reaching the anal angle, and widest just beyond the cell: body dark slaty grey; back of head, collar, and tegulæ blackish. Under surface fuliginous brown, outer border narrowly grey: primaries with a broad subbasal triangular patch, sordid ochreous; a slightly curved discal belt, tapering at each end and crossed by black nervures, pale stramineous: secondaries with the basal third greyish; a central oblique squamose stramineous streak; palpi, tarsi, and the upper surface of the coxæ and femora of the anterior legs brown. Expanse 2 inches 4 lines.

Yokohama (*Jonas*).

146. *Ophiusa dulcis*, n. sp.

Allied to *O. angularis* of Boisduval, but rather smaller, greyer, the lilacine belt of primaries with parallel margins, the brown belt beyond it narrower, feebly and regularly excavated from the middle to the inner margin, but not sinuate angulated as in *O. angularis*; apical blackish spots larger and confluent: secondaries with whitish border. Expanse 1 inch 4 lines.

Yokohama (*Jonas*).

O. angularis is figured in Boisduval's 'Faune de Madagascar.'

Euclidiidæ.

147. *Euclidia consors*, n. sp.

Primaries above like those of *E. cuspidea*, but paler, and with the oblique inner band formed like that of *E. glyphica*: secondaries like those of *E. glyphica*, but rather darker, the discal band broad and not interrupted, although narrow towards the apex; the basal area also complete: body as in *E. cuspidea*. Wings below ochreous, more or less irrorated with brown, with two discal parallel stripes, the outer one of the primaries macular, interrupted in the centre, the inner one of secondaries (where both are angular) indistinct; cells terminating with dusky lunate spots; marginal line blackish, fringe black-tipped: body somewhat greyish. Expanse 1 inch 5 lines.

Yokohama (*Jonas*).

Remigiidæ.

148. *Remigia annetta*, n. sp.

Upper surface like that of *R. gregalis*, excepting that the secondaries are greyish brown, under surface altogether paler and yellower: primaries silky grey, with the costal and outer borders ochraceous, fringe grey; limitation of outer border and a parallel line across the disk dark grey: secondaries ochraceous, irrorated with grey, disk crossed by two parallel greyish lines: body below sordid testaceous; palpi and coxæ of legs sordid orange. Expanse 1 inch 10 lines.

Yokohama (*Jonas*); Hakodaté (*Whitely*).

Also allied to *R. mutuata*.

Thermesiidæ.

149. *Azazia unduligera*, n. sp.

Wings above greyish brown; primaries crossed by two irregularly zigzag central dusky lines, indicating a broad

central band, through the centre of which runs a straight diffused dusky streak enclosing the reniform spot, which is barely indicated, excepting by a small whitish spot; two other dusky transverse lines near the base, the outer one subparallel to the inner central line, the inner one abbreviated; outer border dusky, cut off obliquely at apex by a black litura, which joins a nearly straight transverse black-edged yellowish line; a marginal series of black dots: secondaries crossed by a central bracket-shaped dusky line; outer border slightly dusky, crossed by a whitish nearly straight line; a marginal series of black dots: body greyish brown. Under surface paler; wings crossed by two parallel dusky lines, followed by a diffused externo-discal dusky belt; discocellulars dusky; a whitish line at the base of the fringe; secondaries slightly paler than primaries; venter pale sandy whitish. Expanse, ♂ 1 inch 9 lines, ♀ 1 inch 7 lines.

Yokohama (*Jonas*).

This species has somewhat the appearance of *Entomogramma mediocris*, *Ophiusa bistriaris*, and *Remigia congressa*, but is clearly allied to *Azazia rubricans*.

150. *Selenis lauta*, n. sp.

Allied to *S. costalis* from Natal; wings above pale coppery brown, a broad white costal border occupying nearly the anterior half of the primaries and the basal fifth of the secondaries; two parallel dusky white-edged discal lines; a marginal series of white-edged black dots; fringe grey: secondaries with white costal area: head and thorax white, collar dark brown; abdomen pale brown. Under surface sericeous white: primaries sordid towards the costa, with indications of two parallel greyish discal lines; costa near apex marked with three black dots; all the wings with a submarginal series of black dots and grey fringe: body below creamy whitish. Expanse 8 lines.

Yokohama (*Jonas*).

151. *Capnodes cinerea*, n. sp.

Blue-black, densely irrorated with white scales, so that it looks as if slaty grey striated with blackish: primaries with the basal two thirds of the costal area creamy whitish, interrupted near the base by a blackish spot followed by an oblique black dash, and opposite to the end of the cell by a large ferruginous spot followed by a similar black dash; a large ferruginous spot close to the base; a small fulvous spot in the cell; reniform spot fulvous internally, white externally, divi-

ded by a black line; apical border pale tawny; fringe alternately sordid white and grey: secondaries with the costa pale, fringe as in primaries: body blackish, collar black, prothorax and base of abdomen crossed by white belts. Under surface fuliginous, costa of primaries streaked and spotted with ochreous; a black oval spot in the cell, and a fusiform spot closing the cell, both bordered with creamy white; fringe as above. Expanse, ♂ 1 inch 1 line, ♀ 1 inch 4 lines.

Yokohama (*Jonas*).

152. *Capnodes cremata*, n. sp.

Shining slaty grey, becoming brown towards the borders, crossed by two central parallel sinuous lines of black spots; a discal series of white dots parallel to the outer line, and terminating near anal angle of secondaries in a white *W*-shaped character; outer margin undulated, black, spotted with white, and followed on the fringe by a continuous series of black crescents; fringe also blackish externally, particularly on primaries; costa of primaries irrorated with testaceous and crossed by four or five angular spots of the same colour, from the outermost of which (a >-shaped marking) runs a zigzag pale greyish, black-edged line across the disk: secondaries with a discal series of black-edged testaceous spots: body greyish brown, thorax slaty grey. Under surface fuliginous, crossed by two central angulated dusky lines; a pale discal line; outer margin dusky, fringe greyish; discocellulars blackish; primaries with three decreasing whitish spots on apical half of costal margin; tarsi black, banded with whitish. Expanse, ♂ 1 inch 3 lines, ♀ 1 inch 5 lines.

Yokohama (*Jonas*).

XXXIII.—*On Races of Herring observed in the Sound.* By G. WINTHER *.

THE common herring occurs along the coasts of the Kattegat, through the Sound, the Belts, and a large portion of the Baltic, in several varieties, distinguished by the size and relative proportions of their body, as well as by their habits of life. In this respect the Sound offers some peculiarities on account of its constituting a connecting water between the Baltic and the North Sea, of which the Kattegat is a dependency. There are three distinct races of herrings in the

* Extract of a paper in the 'Nordisk Tidsskrift for Fiskeri' (Copenhagen, 1876).

Sound. One of them spawns in the spring, and corresponds in its habits so closely with other fish which are known to be stationary in the Sound, that in all probability it is stationary like them. This variety is the smallest of the three—a circumstance which is in good keeping with the supposition that it does not at any time leave this comparatively narrow and shallow basin. The other two varieties are migratory, and visit the Sound during the autumn for the sake of spawning—one of them coming from the south, the other from the north, both meeting in that part of the Sound which lies between the islands of Amager and Saltholm and the Swedish coast, and where a chain of shallows, intersected by winding channels, stretches right across. The southern kind of herring agrees with Nilsson's description of the "Kiviksill" (in Skand. Fauna, Fiskar, p. 496); this is in all probability peculiar to the western part of the Baltic, which differs not a little from the portion beyond Bornholm as to the saltness of the water &c. Every autumn large quantities of these herrings travel as far as the Flinterende, a channel, well known to navigators, between Saltholm and the Swedish coast, where they spawn, and from which they again return to the Baltic in the winter. Sometimes, but rarely, easterly winds and strong currents carry them further north after the spawning-season; but until then they do not ordinarily go beyond the Flinterende.

The second of the two varieties which spawn in the autumn arrives in the Sound from the Kattegat, and is intermediate between the Kiviksill and the Kullasill of Nilsson, or ordinary herring of the Kattegat. On account of its habits, this variety is called Bundsild or bottom-herring. Generally speaking it is very regular in its habits, keeping quiet near the bottom of the sea in the daytime, moving about in the deep from about an hour before sunset till an hour after sunset, or even as late as midnight if the moon is high, and then rising to the surface, where it remains until sunrise; but in the spawning-season these herrings move about irregularly, and may be caught at any time. On their journeys they follow the deepest channels, allowing themselves to be carried along by the current, and in stormy weather regularly seeking the lee coast. The temperature of the water in the Sound in the spawning-season is from 50° to 58°·6 Fahr. The principal spawning-ground of this kind is on a submarine plateau north of the Flinterende. After the spawning they usually take a turn south into the bay of Kjöge, and then return northwards to the Kattegat. The most remarkable circumstance in connexion with them is the periodicity which has been observed in the take of them. Herring-periods are known in

many foreign places; but in this case an explanation of the phenomenon can be given. In the Sound a herring-period lasts eight years. At the commencement the fish are few and small; but there is a steady increase in quantity and quality until the fifth and sixth years, which are the best, and are followed by two years of decrease in quantity, after which the large fish suddenly disappear; and in the ninth year only smaller herrings are taken, and the quantity is likewise deficient. How great the difference between the fish in the bad and the good years is, may be concluded from the fact that the length of the meshes of the nets used in 1874, when the last completed period terminated, was 56 millims., whilst in the nets used in 1867, when that period commenced, it was only 39·5 millims. In 1875, when a new period came on, hardly any large fish were taken, but only small ones; and the question naturally arises, What has become of the large breed, and where does the small breed come from? The former evidently have remained in the Kattegat; and the latter were of the southern or Baltic variety, which had spread over the excellent spawning-ground north of the Flinterende, which in ordinary years is occupied by the northern variety, but in that year was free. Having thus established themselves in the northern portion of the Sound, they have gone north into the Kattegat after the breeding-season, instead of returning to the Baltic, as this kind usually do. From the Kattegat they will now return every year to the Sound; and from living in a larger basin, and perhaps on account of the water being more salt there, they will increase in size until the Sound becomes too confined for them; then the shoals, led as they always are by the biggest individuals, will seek other spawning-grounds in the Kattegat, leaving the one north of the Flinterende untenanted; this will then be occupied by another instalment of Baltic herrings, probably in 1883. According to this view the Bundsild of the Danish fishermen is merely the Baltic herring, or Kiviksill, improved by emigration to more favourable localities, where it remains till the improvement has been carried still further; then they cease to return to the sound, but remain in the more open water of the Kattegat. Something quite analogous seems to hold good with regard to the herring in the Great Belt, and perhaps also with regard to other species of fish in these waters. It has not yet been observed whether the converse, a degeneration of races penetrating into the Baltic from the Kattegat, does not take place occasionally. In any case a similar explanation is very likely to afford the explanation of similar fishing-periods in other places.

XXXIV.—*On new Species of* Hydractiniidæ, *Recent and Fossil, and on the Identity in Structure of* Millepora alcicornis *with* Stromatopora. By H. J. Carter, F.R.S. &c.

[Plate XVII.]

In the 'Annals' for 1873 (vol. xi. p. 10) I have inserted a description of a branched chitinous polypary, to which the late Dr. J. E. Gray had given the name of *Dehitella atrorubens*, under the idea that it was a sponge, but which subsequently proved to be a species of *Hydractinia*; and I have now to present the following description of a chitinous polypary like that of *Hydractinia echinata*, but with short branches here and there similar in form and colour to those of *Dehitella atrorubens*, which, on the contrary, grows into a bush-like polypary from a single, smooth, compressed, root-like stem.

Hydractinia arborescens, n. sp. (Pl. XVII. figs. 1–4.)

Polypary chitinous. Laminiform, surmounted by spines and branches indiscriminately scattered over the surface. Colour dark amber-brown (Pl. XVII. fig. 1). Surface following the form of the object over which the polypary may be growing (in this instance a turreted shell like *Phos senticosus*, family Buccinidæ); uniformly even, except where interrupted by the presence of spines and branches; presenting a granulated reticulation of short, broken, raised, serrulated ridges more or less surrounding minute holes once occupied by the polypites and other soft parts of the cœnosarc (figs. 2, *b*, *c*, and 3, *a*, *b*); traversed throughout by a venation of anastomosing grooves whose depth and distinctness is in proportion to their size, the largest being 1-180th inch in diameter (fig. 2, *a*, and fig. 4). Holes of the polypites, which are very numerous and equally present along the course of the vein-like grooves, as in the interstices of the granulated reticulation, may be best seen where the cœnosarc has been well washed out, varying in size, according to their office, from 2 to 3-1800ths inch in diameter (fig. 2). Spines conical, variable in size and length, scattered more or less partially over the surface so as to leave here and there plane intervals of greater or less extent; often growing into erect branches variable also in length and thickness (fig. 1, *a a a*), the largest, which in this instance forms one of a group at the anterior extremity of the shell, being 1-12th inch in diameter at the base (fig. 1, *b*), and the remaining longest portion of the rest (for they have all been broken off more or less close to their origin in the laminiform part of the polypary) 1-3rd

of an inch. In all there were thirty branches or processes, of which those at the extremities of the shell respectively were the largest and most subdivided. Spines and branches presenting the same kind of surface as that of the rest of the polypary, with the exception that the serrulated ridges of the granulated reticulation being longer, thus give rise to oblong or more or less elongated interstices; those on the spines forming a series of grano-serrulated ridges, diminishing in number upwards, until the last three or four, uniting into a point at the summit as in *Hydractinia echinata*, thus close the cancellated structure of which the spine is otherwise composed. Branches more or less divided and covered with small spines, which terminate the free ends in an alternate manner like those of *Sertularia*. Internal structure cancellous throughout and in direct continuity with the surface through the holes of the polypites, so that the cœnosarc thus forms a continuous mass, in which the chitinous, clathrous polypary, having been developed, becomes its skeleton or organ of support, sometimes extending into the calcareous material of the shell itself, and transforming the whole lip, as in the present instance, into polypary (fig. 1, *d*). Size depending upon that of the object over which the *Hydractinia* may be growing; in the present instance the shell covered by it is $2\frac{1}{4}$ inches by $\frac{3}{4}$ inch broad in its greatest diameters.

Hab. Marine, growing over hard objects; in the present instance completely covering a shell like *Phos senticosus* or *Fusus sulcatus*.

Loc. ? Polynesia.

Obs. The specimen from which the above description has been taken now belongs to the British Museum, and was found, without any label or indication of its locality, among the late Dr. Bowerbank's collections. Whether by the waves originally, or subsequently from other causes, it has been lamentably treated; for at the present time, as above stated, out of the thirty short branches which it once possessed, not one now remains entire, the whole having been broken off at variable distances respectively from their origin in the laminiform portion, and some close to it; while the only branched one which is left projects laterally from that part of the polypary which once *entirely* covered the apex of the shell as well as all other parts, but which is now broken away at this part, on the opposite side, so as to expose the apex of the shell itself, the only part consequently now uncovered (fig. 1, *c*).

At first sight the specimen looks like a shell with branched spines; but on closer inspection this is found to be a mistake, although the branches in some parts may have been initiated

by the presence of short spines on the shell itself. At the same time, as with the lip so with the branches, the whole spine may have been replaced by the polypary of the *Hydractinia*; yet then the shell could not have been either of those mentioned, especially as the largest and greater number of branches are to be found at the extremities; but I shall hereafter show that such branches may arise independently of the presence of any spine at all on the shell over which a *Hydractinia* may have grown. The large branches are so like in form, structure, and colour, together with their spines, to the branches of *Dehitella atrorubens* that no doubt can be entertained of the latter being identical with the former, except in specification; while the grooved, anastomosing venation on the surface, which does not exist on *D. atrorubens* and the other bush-like forms that I have examined, is equally identical with that of the fossil species *Hydractinia pliocena* ('Annals,' 1877, vol. xix. pl. viii. fig. 8), which is also present, but less markedly seen, in *H. echinata*.

This grooved venation (fig. 4), which is the bed of the cœnosarcal tubulation in which the whole organism originates from the commencement, and is the same in structure and function where it forms the first sarcodic lamina on the shell ('Annals,' 1877, *l. c.* p. 46) as on the surface of the full-grown polypary, is more or less repeated as a proliferous membrane on the surface of every layer, although it may not be so marked in some as in other species; yet, in the present instance, it is as striking in the chitinous polypary of the recent *H. arborescens* as it is in the assumed calcareous one of the fossil species *Hydractinia pliocena*, and will be found even more developed in the new fossil species I am about to describe.

Previously, however, it is desirable that I should add a few words on the recent species.

Hydractinia calcarea, Cart.

Since the description of this was published ('Annals,' 1877, vol. xix. p. 50), Mr. Thomas Higgin, of Liverpool, has kindly sent me some more specimens on equally small shells of *Fusus* and *Nerita* respectively, from the same locality, many of which possess short branches which, in two instances, growing from a specimen on the smooth surface of a *Nerita*, at once point out that *they*, at all events, do not originate in the presence of a spine on the shell which may have become covered or entirely replaced by the polypary of the *Hydractinia*, as at first supposed ('Annals,' 1877, *l. c.* p. 51), but are distinct branches or processes similar to those of the

chitinous species just described. On the smooth species of *Nerita*, to which I have alluded, the development of the branch can be followed throughout from the spine of the polypary to its ultimate form, which in the largest specimens is about 1-10th inch in diameter and 1-4th of an inch long, with a tendency to assume a compressed, palmate, bifurcate shape at the free extremity. So it should be remembered that the calcareous polypary of *Hydractinia calcarea* may also be branched like the chitinous one of *H. arborescens*.

Hydractinia Kingii, n. sp.

Fossil. Polypary massive, growing over a turreted shell, somewhat like that supporting *Hydractinia arborescens*, compressed, extending here and there irregularly into a short, thick lobe, process, or branch. Composed of compact, greyish-white limestone. Surface uniformly even, thickly veined with anastomosing grooves amongst granular ridges once surrounding the holes of the polypites, which are now filled up and undistinguishable from the rest of the calcareous material; pustuliferous—that is, presenting numerous depressed papillary elevations, which are the representatives of the spines in other species, and where broken open (as many are) disclosing the grooved venation on the surface of the subjacent layer. Internal structure concentrically laminated, presenting in a vertical section rows of chambers (? the hollow bases of the pustules of each layer), between which are the vertical tubes of the polypites, now, for the most part, filled with calcareous matter, but, where still hollow, possessing a diameter of 3-1800ths inch, and at their openings into the roofs of the chambers respectively a calcareous diaphragm with central hole, similar in form to that of *Hydractinia calcarea* ('Annals,' 1877, vol. xix. p. 51, pl. viii. fig. 4, *g g*), but apparently without its repetition which is seen along the vertical tubes in *Hydractinia pliocena*—a point, however, that must be decided by a more favourable specimen than the one which I possess. Size of the fragment from which the above description is taken about an inch square and half an inch thick. Thickest portion of the polypary from the shell outwards 5-12ths inch; largest lobo-branch, which is circular in the section, but whose extremity has been broken off, ¼ inch in diameter, and the same in length.

Hab. Marine, on a turreted shell like *Phos senticosus*; or it may have been a *Cerithium*, as there is only a fragment of the apex left in the specimen for this determination.

Loc. ? Subapennine strata.

Obs. At first I thought this was a specimen of *Hydractinia*

pliocena; but subsequent and more particular examination shows that it has several specific differences, viz. :—1, the visible venation is much denser in *H. Kingii* than in *H. pliocena*; 2, there are no spines on the former, which, as before stated, are represented by pustuliform elevations; 3, the entire mass is irregular in form and extended into a thick lobo-branch or process here and there; 4, the vertical tubes present no diaphragm or septal divisions, except the one above mentioned. It has been named after Prof. King, of Galway, who kindly sent me the specimen, which he thought came from the Subapennines and had already received a name.

Millepora alcicornis.

As this is a well-known species, having been named by Linnæus, stated by Ellis and Solander to be so abundant in the West Indies as to be "used principally for burning into lime," and pronounced by Agassiz, in 1859, to be "very nearly related to the Hydractiniæ," I shall only describe so much of it (from a dried fragment which, by accident, has lately fallen into my hands with fragments of sponges which indicate that it came from the seas between the two Americas) as may be necessary for the purpose of showing how closely allied in structure its corallum or polypary is to that of *Stromatopora*.

Its specific designation well indicates the general form. The surface is harsh to the touch from being composed of the pointed free ends of a meandering reticulation of anastomosing more or less flat fibre, whose interstices form the openings of a subjacent structure, which will be more particularly described hereafter, rendered uniformly uneven or bossed by gentle elevations and depressions; over which, scattered more or less irregularly, are many apertures that may be divided into two sets, viz. large and small, the latter most numerous; the largest, which more especially have a toothed or subasteroid margin, are about 1-120th inch in diameter and 1-12th inch apart, while the smaller ones are about 1-225th inch in diameter and 1-48th inch apart; but both vary slightly in size and in their distances from each other. Besides this, the surface presents here and there an intricate tubular venation composed of chitinous canals in relief, more or less covered with calcareous material, whose minute branches anastomose freely over the points of the meandering reticulation mentioned, and, in many instances, become lost beneath it, the largest branches averaging 1-360th inch in diameter. I note this particularly because we shall find remnants of it by-and-by (fig. 8, *a*) on the surface of the fossil called

Millepora Woodwardii). *Internal structure*:—The surface, as already intimated, is the outward limit of a subjacent cancellated structure (fig. 5, *b b*), formed by the anastomosis of more or less flattened reticulated fibre; and this, which is the staple substance of the corallum, is remarkable for its minuteness and the tortuous form of both its solid and cavernous parts, the latter in the fresh state being occupied by the cœnosarc, which is thus brought into direct continuation with the exterior. After forming a layer of about 1-180th inch in thickness and of yellowish-white colour, it becomes more compact and presents a bluish tint, which thus establishes a distinct line of demarcation between the two; while, when the superficial layer is carefully picked off with a sharp point, the horizontal surface of the subjacent one is seen to be traversed by a deep grooved venation similar to that of *Hydractinia arborescens*, &c., with here and there the remains of a dry sarcodic cœnosarcal tube in it running along its course, thus indicating that the surface-layer, which is less compact, of a different colour, and overrun here and there by a tubular venation, is the external layer of the growing corallum; and therefore we may fairly infer that successively the corallum has been formed in this way throughout, although somewhat modified in density &c. by age and subsequent development.

Having now described the staple substance of the corallum from the surface to the axis of the branch (that is, from the circumference to the centre), we have next to follow the large apertures in the same way. These, in the vertical section, may be observed to be the openings of tubular spaces varying from 1-360th to 1-180th inch in diameter, which descend more or less vertically and nearly to the central plane that separates the two laminæ of which the elkhorn-like compressed branch is formed (fig. 5, *a a*). Further, it may be observed that these spaces are horizontally but unequally divided into several compartments by very thin transverse septa or *tabulæ* (fig. 5, *c*), and that their internal surface is plentifully perforated by more or less rounded apertures (fig. 5, *e*) such as may be seen in *Stromatopora*, which communicate with the tortuous cavities of the cœnosarcal skeleton or cancellated structure of the corallum, so that the tubular spaces are as much foraminated (fig. 5, *c*, *d*) as the cœnosarcal skeleton is cancellated, being simply excavated in the midst of the latter, without the least trace of any distinct parietes after the cœnosarc has been abstracted. Indeed it is very remarkable that all the cavities of the cœnosarcal skeleton (that is, of the whole corallum, like that of *Parkeria* &c.) are formed upon the cœnosarc (identical in this respect with the can-

cellous structure of bone), so that, in the absence of the latter, as just stated, none of them presents the least sign of a wall. The only part which appears solid or different from the rest in structure is the *tabula* or transverse septum of the tubular excavations (fig. 5, *c*). Indeed, here as elsewhere in the Hydractiniidæ, it is the intricate anastomosis of the minute branches of the cœnosarc which leads to the formation of the peculiar, cancellated, cœnosarcal skeleton, which, again, is as indicative of the structure of the Hydractiniidæ as it is opposed to that of the Foraminifera. Not unfrequently the *tabula* is surmounted centrally by a kind of style, which, in some species of *Stromatopora*, seems to be indicated by the presence of a white point in the centre of the transparent calc-spar filling the rest of the calicle.

Finally, if the elkhorn-like branch of *Millepora alcicornis* be split in two through the centre parallel with its flat surface, the plane of each part thus exposed will present concentric lines of lamination in the cancellous structure, which, extending from side to side parallel with the plane, indicate the progressive formation of the flat branch upwards from the point at which it commenced to expand. These lines of lamination, however, are, in accordance with the rest of the structure, not indicated by distinct laminæ, but by the position of the rows of apertures in the cœnosarcal skeleton or corallum.

Thus we have every thing structural in the corallum of *Millepora alcicornis* that is to be found in *Stromatopora*, excepting the *stelliform* systems of venation.

What, then, were those "stelliform systems" which, in my paper on *Hydractinia*, &c. ('Annals,' 1877, vol. xix. p. 68, and pl. viii. figs. 19 &c.), I have likened to the superficial stelliform excretory canal-systems of some sponges, and suggested a like function? I need hardly answer the question, after what has been above stated, especially when they are to be seen on the upper surface of every layer of a *Stromatopora* as it is split off from the entire specimen. They were not water-vascular excretory systems as in sponges, but tubular venations of the cœnosarc on the surface, probably filled with "entodermic cells," as will appear hereafter, preparing the way proliferously for the new layer; and, although in no instance that I know of, yet there may be an existing species of *Millepora* in which the grooved venation, instead of meandering generally over the surface in large branches and sending off smaller ones, which by subdivision become still smaller, and ultimately intermingle with each other (like the capil-

lary system of blood-vessels in the warm-blooded animals), proceeds from central points, and thus resembles the stelliform arrangement characteristic of *Stromatopora*.

That this stelliform arrangement should not have been exactly the same even in the different species of *Stromatopora* is as certain as that in all it seems to have been connected with the same function, and that function to have been what has been above stated. But let us now turn for a few moments to the able observations of Mr. H. Moseley, who has studied the Milleporidæ in their living state (Phil. Trans. 1876, vol. 166, p. 91).

Mr. Moseley states that specimens of *Heliopora cœrulea*, which were obtained at Zamboangan, in Mindanao, one of the Philippine Islands, and *Millepora alcicornis*, in "great profusion" at Bermuda, were found to be as different in their minute structure as in their general form; for while the corallum of *Heliopora cœrulea* was observed to consist of "tubes of circular section, of nearly uniform diameter, closely packed side by side . . . . with their walls, where touching, fused together," and the intervals filled up by a hard tissue, which appears above the margins of the tubes "in papilliform prominences" (*l. c.* p. 99), that of *Millepora alcicornis* was found to be composed of a network of tortuous branches of hard tissue, in which "the soft tissues appear to occupy a series of tortuous canals," "that lead from the calicles in all directions, and, anastomosing freely with one another, join the cavities of the surrounding calicles" (*l. c.* p. 113)—to which, as before stated, might be added that the tubes of the calicles are imbedded in this tissue at variable distances from each other respectively, as further indicated by the distance between these apertures on the surface.

Moreover Mr. Moseley describes our "grooved venation" as "canal-systems," the tubes of which are "not only lined by, but also always more or less filled with entodermic cells." They are divided into two systems, viz. a deep or horizontal and a superficial or more or less vertical system—the former being that which I have more particularly described in *Millepora alcicornis*, and whose canals, cut across in the vertical section of this species, may be seen just below the last-formed or external layer in the same position as that figured by Mr. Moseley in *Heliopora* (*l.c.* p. 105, pl. viii. fig. 1, V′, and pl. ix. fig. 8). That this is not a water-vascular system is thus proved beyond a doubt, as clearly as that it is the grooved venation, in which the original soft tube may be seen, as first noticed in *Hydractinia echinata* ('Annals,' 1877, vol. xix.

p. 48, pl. viii. fig. 3), and now in a dried state subsequently in the venation on the penultimate layer of *Millepora alcicornis.*

But these views are opposed to those of Drs. Nicholson and Murie, in the report of whose paper on the minute "structure of *Stromatopora*," read before the Linnean Society on the 20th Dec. last, we read that the authors "discard the notion of its alliance [that of *Stromatopora*] with the Nullipores, or belonging to the corals, Hydrozoa, or Foraminifera;" while, "under negative evidence," they would constitute for the Stromatoporids "a new order of calcareous sponges—Stromatoporidea." Herein, I need hardly state, it is impossible for me to acquiesce.

Millepora Woodwardii, cast. (Pl. XVII. figs. 6–9.)

Lastly I must advert to the fossil from the "Lower Chalk" of Dover, kindly sent to me by Mr. Woodward of the British Museum, last year, and described in the 'Annals' (vol. xix. p. 64) under the provisional name of "*Bradya tergestina*," Stache, MS."—chiefly for the purpose of giving a figure of it, which I then had not the opportunity of doing, as my plate of illustrations had been filled up previous to its arrival.

Having in my private journal, however, accurately sketched the upper portion of it, together with the section, of the *natural size*, it is herewith reproduced (figs. 6, 7), as well as a magnified view of the fragments of the "creeping, branched, tortuous, dendriform fibre in prominent relief," mentioned at p. 65 (*l. c.*), that remains on its surface (fig. 8, *a*), and a diagram, to scale, of one of the tubular spaces (fig. 9, *a*), now observed to be septate like that of *Millepora alcicornis.* To the great resemblance of the stelliform systems of venation (fig. 6, *aa*) to, if not identity with, those of *Stromatopora* I have already alluded; I have also likened them to the "creeping, branched, tortuous, dendriform fibre in relief" on the surface of the chitinous one, *Hydractinia echinata*; and now they may be identified with the calcareous one on the surface of *Millepora alcicornis.* I have also since seen the base of this fossil, which presents no stelliform venation, but an irregular surface indicative of that of attachment, while the upper or sectionized polished part shows that the tubes had septa (*tabulæ*) like those of *Stromatopora* and *Millepora alcicornis*; lastly, I observe towards the periphery a great number of minute spherical bodies of different sizes below the 3-1800ths inch in diameter, which appear to have been ova.

Can D'Orbigny's *Stellispongia variabilis*, which extends from the Trias to the Upper Chalk (Senonien—not "Sues-

sonien" or Eocene as stated by mistake in my paper, 'Annals,' *l. c.* p. 67), be allied to *Millepora Woodwardii?* At all events the former brings down the stelliform systems of venation seen in the Silurian *Stromatopora* &c. to the Chalk age, as indicated by the type specimen from the Trias, given by D'Orbigny (Cours élément. Paléont. et Géologie, vol. ii. p. 411, fig. 407), of which a tracing will be found among the illustrations (fig. 10).

Through the kindness of Mr. Woodward I have also been able to examine the little globular fossils generally, in the British Museum, which have been obtained from the chalk of Dover, when being washed and prepared for officinal purposes. These would appear to have been first called by Phillips *Millepora globularis* ('Geology of Yorkshire,' 1829, vol. i. p. 234, tab. 1. fig. 12), and are identical in structure with *Millepora Woodwardii*, except that they have no stellate venation or branched tubulation in relief on the surface. Moreover they are frequently more or less perforated by a cylindrical cavity filled with chalk, in which they are identical with some specimens of *Parkeria*, wherein the cavity appears, from its heterogeneous contents, to have been filled with "sea-bottom" (p. 59, *l. c.*); while, from the radiated structure in both *Millepora globularis* and *Parkeria* not having been altered or turned out of its course by the presence of the cavity, it would appear that the latter had been made by some organism after the *Millepora* or *Parkeria* had completed their growth respectively. At the same time, in *Parkeria*, a nucleus of this heterogeneous material frequently appears, singly or in plurality, in the midst of the structure, while some specimens of *Millepora globularis* present two or more such cavities of different depths, indicating that, if the excavating organism perished or left its cavity when the latter was shallow, and the Millepore or *Parkeria* continued to grow afterwards, the cavity might appear in the midst of the structure filled, as we see it in *Parkeria*, with "sea-bottom." Sometimes the excavation passes directly through both *Millepora globularis* and *Parkeria*, simulating, as Mr. Woodward states, the beads of a "prehistoric race;" and sometimes, as just stated, there may be more than one excavation present.

Frequently *Millepora globularis*, when fixed, assumed a hemispherical shape; and also, having frequently grown as if on a conical body, the base presents a corresponding excavation, which is annulated concentrically with alternate grooves and elevations, covered with a smooth compact material, which contrasts strongly with the rough apertured surface of the hemispherical or free side, arising from the projection of

the free ends of the fibre forming cœnosarcal cancellated structure between the apertures of the tubular spaces (? *Lunulites urceolata*, Phillips, *l. c.*, fig. 11). This form also occurs with a conical upper surface, when it somewhat resembles that species of Foraminifera called *Orbitolina lenticularis*, but differs from it in the concentric annulation of the exterior being on the convex instead of on the concave side, to say nothing of the internal structure, as may be seen by my elucidation of this fossil ('Annals,' 1861, vol. viii. pl. xvii. figs. 5–9).

Lastly, there is another subglobular free form, with one or more conical elevations on its upper surface, from which grooves radiate downwards, and, branching as they descend over the globular part of the fossil to its base, become shallower, and finally disappear before reaching the centre. This appears to be only a *free* form of *Millepora Woodwardii*.

In all these fossils we may observe that the remarkable form of cancellated structure which I have described in *Millepora alcicornis*, is excavated by tubular spaces that radiate from the centre to the circumference, where the same structure projects in little points above the surface around their apertures, identically as the horny structure of the same kind projects above the apertures of the polypites in the polypary of *Hydractinia echinata*. This structure is the same in all the branched species of *Hydractinia*, whether living or fossil, chitinous or calcareous; and it is perhaps nowhere seen more beautifully than in the branched *Chitina ericopsis*, where there is no cuticle and no core to the stems, which thus entirely and exclusively consist of this peculiar cancellated tissue excavated by tubular spaces. Such cancellated structure is never seen in any of the Foraminifera, not even in *Polytrema*, and only in a few stony corals; so that its presence, as before stated, appears to be decisive against the *Hydractiniæ* being Foraminifera.

Having, on the 1st January last, received, with three other species of fossils allied to *Hydractinia*, from Dr. Steinmann of Munich, two specimens of *Millepora globularis* (*Porosphæra*, Steinmann) from the Upper Chalk of Hanover, which he very properly identifies with *Bradya tergestina*, the old generic name of Phillips must take precedence of the latter; and therefore I have called the Dover fossil "*Millepora Woodwardii*;" nor will it appear strange after this that Phillips should have applied the name of "*Millepora*" to these little fossils (*l. c.*), subsequently changed by Etheridge to *Coscinopora* (ed. 1875).

When, too, we remember that *Millepora alcicornis* is found under a "variety of forms," one of which is stated by Ellis

and Solander (p. 142) to be "like so many beads of a necklace," and that the structure is radiated, we probably should find these "beads" not only very much like *Millepora globularis*, but, in their hemispherical condition, diminutive forms of *Stromatopora*, saving the stellate arrangement of the cœnosarcal venation.

Millepora globularis and *M. Woodwardii* appear to be closely allied in structure; but as yet I have only been able to see the septa (tabulæ) in the tubular spaces of the latter, and this in only one instance (fig. 9); so it is either uncommon or difficult to recognize.

There is yet another form in the British Museum, about the same size as *Millepora Woodwardii*, which was free. It was irregularly elliptical (having been now cut in two), compressed, and seems to have been globular at first, subsequently overlapped by an additional growth, which causes one side to appear under the form of four triangular segments, crucially arranged, with their points in the centre, two of the segments opposite, being the overlapping parts of the last growth. But the structure otherwise is the same as that of all the rest, viz. radiating tubular spaces, increased in number by branching towards the circumference, where their apertures, therefore, are of unequal size and at slightly variable distances apart, situated in the midst of the peculiar cœnosarcal skeletal tissue above described. The specimen also presents four or more cylindrical excavations on its surface of different depths, one of which reaches nearly to the centre of the fossil.

Thus the forms of this organism may be still more numerous, and, after all, like those of *Millepora alcicornis*, only various growths of the same structure; hence the necessity of a review of all the species of D'Orbigny's *Coscinoporæ* and the like, with which they seem to have been more or less identified, that they may be respectively relegated to their proper position in the animal kingdom.

Postscript, Feb. 7, 1878.

Since the above was written I have received from Dr. Steinmann (on the 4th inst.) a copy of his interesting paper, entitled "Ueber fossile Hydrozoen," published in the 'Palæontographica,' n. F. v. 3 (xxv.), p. 101, in which are enumerated all the species allied to *Hydractinia*, both living and fossil, that have been identified, adding to the latter three new ones, viz. *Sphæractinia diceratina*, *Ellipsactinia ellipsoidea*, and *Cylindrohyphasma Milaschewitschi*, besides changing the generic names of *Millepora globularis*, Phillips,

to *Porosphæra*, and *Ceriopora crispa* et *favosa*, Goldfuss, to *Thalimina* respectively.

It is worthy of notice that the specimen of *Cylindrohyphasma Milaschewitschi*, which consists of a cylindrical portion 2 inches long and 9-24ths inch thick, should have its cavity filled with sea-bottom—that is, a heterogeneous mixture of sand and minute Foraminifera &c., like that which I have stated to occur in *Parkeria*. How does this material, viz. sea-bottom, get there? In a specimen from the "Chalk Marl" just received from Mr. Charles Moore, F.G.S., there is the same condition, viz. the growth of a Hydrozoic (? calcareous) polypary or corallum, somewhat like that of *Parkeria*, round a nucleus of "sea-bottom"—that is, quartz-sand and minute Foraminifera &c. Certainly it was the habit of these Hydrozoa, as it was that of *Stromatopora*, preceded by their soft, sarcodic, proliferous membrane, to run in between and over every thing with which they came into contact. I possess a block of *Stromatopora* from the Devonian Limestone in the neighbourhood of Ipplepen (near Torbay) and its environs, in which this is represented upon a large scale, there being fragments of half a dozen other things besides shells &c. in a mass of *Stromatopora* which must have originally been two or three feet at least in diameter. It was given to me by my friend Mr. William Vicary, of Exeter, who has perhaps as fine a collection of *Stromatopora* as any in existence.

In his concluding remarks Dr. Steinmann places *Stromatopora* under *Sphæractinia*; *Loftusia* under *Ellipsactinia*; and *Parkeria* with *Porosphæra*.

Porosphæra is adopted, as before stated, for Phillips's *Millepora*, generically; and unquestionably the use of *Millepora* here is confusing; at the same time it shows how sensible Phillips was of the real nature of this fossil originally.

Dr. Steinmann's paper is beautifully illustrated, and an advance upon the subject which cannot be ignored by those who wish to keep pace with palæontological knowledge. The slight discrepancy that exists between my figure of *Hydractinia arborescens* and that given by Dr. Steinmann arises from the latter having been lithographed from a rough sketch and the former from a finished drawing.

As regards the Stromatoporoid origin of *Eozoon*, however (footnote, p. 114), of which a type specimen is now before me, it might be observed that "moss-agates" from the trap of Western India frequently present arborescent *glauconite* as much like organic remains as the so-called *Eozoon* is remote from such resemblance. When, therefore, the figure in the metamorphic rock is even as like organic remains as that in

the Plutonic one, it will be quite time to speculate as to its original nature; till then it must remain in the abode of *omne ignotum pro magnifico*, into which science forbids her votary to enter. (The specimen of *Eozoon* to which I have alluded (a slice about $2\frac{1}{2} \times 2$ inches), was sent by Dr. Carpenter to Profs. King and Rowney, of the Galway College, Ireland, who kindly presented it to me.)

EXPLANATION OF PLATE XVII.

Fig. 1. *Hydractinia arborescens*, n. sp., on a turreted shell. Natural size. Branches of the specimen broken off. *a a*, branches; *b*, largest branch; *c*, apex of the shell exposed, from a portion of the polypary having been broken off; *d*, lip of shell transformed into polypary, also broken.

Fig. 2. The same. Diagram of portion of surface of the polypary, to show:—*a a*, large branch of the grooved venation passing through the surface; *b b*, apertures of the polypites, &c.; *c c*, lines indicating the position of the grano-serrulated ridges of the polypary. Scale about 1-96th to 1-1800th inch.

Fig. 3. The same. Diagram of portion of surface of polypary, more magnified, to show:—*a a*, apertures of polypites &c. in relation to *b b*, grano-serrulated ridges. Scale about 1-48th to 1-1800th inch.

Fig. 4. The same. Diagram of portion of surface of polypary, to show the grooved venation *only*. Magnified about 2 diameters.

Fig. 5. *Millepora alcicornis*. Diagram of portion of corallum including vertical section of part of a tubular space. Much magnified. *a a*, tubular space; *b b*, cœnosarcal skeleton; *c*, transverse septa or *tabulæ*; *d*, apertures of the cancelli in the cœnosarcal skeleton; *e*, the same, opening into the tubular space. Transverse diameter of tubular space about 1-120th inch.

Fig. 6. *Millepora Woodwardii*. Surface of upper half. Natural size. *a a*, systems of stelliform venation. [N.B. For the description of this fossil see 'Annals,' 1877, vol. xix. p. 64, under the provisional name of "*Bradya tergestina*, Stache, MS."]

Fig. 7. The same. Horizontal section. Natural size. *a*, horizontal section of tubular spaces at the centre; *b*, oblique section of the tubular spaces at the circumference.

Fig. 8. The same. Diagram of a portion of the surface, much magnified, to show the fossilized fragments of a superficial tubulation like that appearing above the outer layer on some parts of *Millepora alcicornis*. *a*, branches of tubulation; *b*, subjacent apertures of calicles or tubular spaces. Scale about 1-48th to 6-1800ths inch.

Fig. 9. The same. Diagram of portion of the corallum, including a vertical section of part of a tubular space bearing septa or *tabulæ*. More magnified. *a a a*, radiating tubular spaces; *b b*, cœnosarcal skeleton between the radiating tubular spaces; *c*, transverse septa or *tabulæ*; *d*, apertures of the cœnosarcal skeleton in the tubular space; *e*, surface of corallum.

Fig. 10. *Stellispongia variabilis*, D'Orb., from the Trias. Traced from his figure (Cours élément. de Paléontol. et Géologie, vol. i. p. 214, fig. 388). *a a*, systems of stelliform venation; *b*, portion of surface, more magnified.

XXXV.—*Descriptions of a new Genus and of new Species of* Halticinæ. By JOSEPH S. BALY, F.L.S.

Genus HYPHASIS, v. Harold,

Deutsch. ent. Zeit., Dec. 1877, p. 433.

Corpus rotundato-ovatum, modice convexum. *Caput* in thoracem insertum, *facie* perpendiculari; *encarpis* distinctis, contiguis: *carina* leariformi, elevata; *antennis* filiformibus. *Thorax* transversus, lateribus reflexo-marginatis. *Scutellum* trigonatum. Elytra thorace latiora, reflexo-marginata, modice convexa, confuse punctata; *limbo* inflexo concavo, margine externo deorsum producto. *Pedes* mediocres, *femoribus* posticis valde incrassatis; *tibiis* dorso canaliculatis, posticis extus ante apicem emarginatis, apice spina acuta armatis; *tibiis* anticis quatuor apice inermibus; *tarsis* posticis articulo basali duobus sequentibus conjunctis longitudine æquali vel longiore; *unguibus* posticis inflatis; *unguiculis* appendiculatis. *Prosternum* oblongum aut anguste oblongum, apice obtusum aut truncatum, disco plano aut longitudinaliter concavo; *acetabulis* anticis apertis. *Mesosternum* obliquum aut subhorizontale, apice emarginatum.

The short, plane or longitudinally concave prosternum, the concave inflexed limb of the elytron, together with the general form of the body, will, combined, separate this genus from *Homophoeta*; the form of the prosternum, together with the difference in the length of the basal metatarsal joint, will separate it from *Œdionychis.*

Hyphasis coccinelloides.

H. rotundato-ovata, modice convexa, pallide flava, nitida, antennis (basi excepta) fuscis; oculis nigris; thorace lævi, obsolete punctulato; elytris subcrebre punctatis, utrinque maculis subrotundatis quinque nigris ornatis, harum prima communi circa scutellum, secunda vix infra basin supra callum humerale, rotundato-ovata, duabus prope medium transversim positis, quintaque ante apicem, prope limbum externum sita.

Long. $2\frac{2}{3}$ lin.

Hab. Borneo, Sarawak. Collected by Mr. Wallace.

Vertex shining, impunctate; encarpæ transversely quadrate; carina elongate, its upper end thickened; antennæ with the four lower joints flavous, stained with piceous, the rest fuscous. Thorax more than three times as broad as long; sides broadly margined, strongly reflexed, rounded and converging from base to apex, parallel at the extreme base, the anterior angles thickened, armed with a small excurved, acute tooth; surface nitidous, faintly impressed here and there with fine punctures; lateral margin longitudinally excavated. Apex

of scutellum obtuse. Elytra much broader than the thorax, the shoulders broadly rounded; above moderately convex; sides dilated, reflexed; surface rather strongly punctured. Basal joint of metatarsus longer than the following two united.

Hyphasis bipustulata.

H. late ovata, modice convexa, picea, nitida, antennis (basi excepta) nigris; thorace lævi, fere impunctato; elytris nigro-piceis, tenuiter sed evidenter punctatis, utrinque pustula magna ovata flava ornatis.

Long. 1⅘ lin.

Hab. Celebes (collected by Mr. Wallace), also Birmah.

Head and thorax fulvo-piceous; vertex shining, impunctate; encarpæ transverse, oblong; antennæ nearly three fourths the length of the body, filiform, the two lower joints piceous, the rest black. Thorax three times as broad as long; sides rather broadly margined, reflexed, rounded, converging at the base, and again from behind the middle to the apex; anterior angles thickened, obtuse, slightly excurved; upper surface smooth and shining, nearly impunctate, a few fine punctures only being seen under a powerful lens; lateral margin longitudinally concave. Scutellum piceous, its extreme apex obtuse. Elytra much broader than the thorax, rotundate-ovate, the shoulders broadly rounded; above moderately convex, the lateral margin reflexed; nigro-piceous, obscure rufo-piceous on the middle disk, finely but distinctly punctured; each elytron with a large subovate pale yellow patch, which extends from just before to some distance below the middle of the disk, and laterally from within the outer limb to within a short distance of the suture. Basal joint of hinder tarsus equal in length to the following two united.

Hyphasis piceipennis.

H. rotundata, modice convexa, fulva, nitida, capite thoraceque rufo-testaceis, antennis (basi excepta) oculisque nigris, tibiis tarsisque nigro-piceis; elytris tenuissime punctatis, piceis.

Long. 2 lin.

Hab. Borneo, Sarawak.

Face elevated between the eyes; the latter large, prominent; encarpæ quadrangular, well defined, contiguous; carina linear, strongly elevated; antennæ nearly three fourths the length of the body, filiform, two lower joints fulvous, the rest black, the third joint twice the length of the second, rather shorter than the fourth. Thorax three times as broad as long; sides broadly margined, reflexed, obtusely rounded, converging in

front, the anterior angles armed with a slightly excurved, obtuse tooth; upper surface nitidous, very minutely punctured, the puncturing only visible under a lens. Scutellum trigonate, its apex acute. Elytra much broader than the thorax, the shoulders broadly rounded; above moderately convex, flattened on the disk, minutely punctured, lateral margin narrowly dilated, impressed on its inner edge with a single row of distinct punctures. Prosternum twice as broad as long, its sides parallel, its apex truncate, its surface longitudinally concave. Apices of the thighs piceous; tibiæ and tarsi nigro-piceous; hinder tibia armed near its apex with a short acute tooth; hinder metatarsal joint equal in length to the following two united.

Hyphasis nigricornis.

H. late ovato-rotundata, modice convexa, dorso paullo deplanata, flava, nitida, antennis (basi excepta) oculisque nigris, scutello, pectore tarsisque piceis; thorace minute punctato; elytris distincte, subcrebre punctatis.

Long. 2½ lin.

Hab. Northern India.

Face elevated between the eyes, the latter smaller and more widely separated than in *H. piceipennis*; encarpæ transverse-quadrate, contiguous, separated from the front by a deep transverse depression; carina strongly raised; vertex and front nitidous, impressed with a few minute punctures, only visible under a lens; antennæ more than three fourths the length of the body, slender, filiform, the three lower joints obscure flavous, the rest black, the third joint one half longer than the second, distinctly shorter than the fourth. Thorax more than three times as broad as long; sides broadly margined, reflexed, nearly straight and parallel behind the middle, rounded and converging in front, the anterior angles armed with an obtuse, excurved tooth; hinder angles distinct, subacute; upper surface impressed with minute punctures, the interspaces still more finely punctured. Scutellum scarcely longer than broad, trigonate, its sides subsinuate, its apex subacute. Elytra very much broader than the thorax, the shoulders broadly and somewhat obliquely rounded; upper surface distinctly and rather closely punctured, the lateral margin broadly dilated, only slightly reflexed. Prosternum narrowly oblong, slightly sinuate on the sides, the apex obtuse; surface only faintly excavated. Hinder tibiæ unarmed; hinder metatarsal joint longer than the following two united.

Hyphasis Wallacei.

H. late ovata, convexa, sordide fulva, nitida, antennis nigris, tarsis, tibiis posticis apice, tibiis anticis totis femoribusque anticis dorso nigro-piceis; thorace lævi, lateribus late nigris; elytris subfortiter punctatis, utrinque plaga magna humerali, ad marginem adfixa, postice oblique truncata, alteraque pone medium, subovata, apice acuminata, vix intra marginem posita, ornatis.
Long. 3 lin.

Hab. Malacca (*Wallace*).

Vertex smooth, impunctate; eyes large, rotundate, prominent, black; encarpæ well defined, obliquely transverse, quadrangular; carina elongate, its upper half thickened; antennæ nearly three fourths the length of the body, black, lower portion of basal joint obscure flavous. Thorax three times as broad as long; sides broadly margined, strongly reflexed, rounded, the anterior angle armed with an excurved, subacute tooth, hinder angle with an obtuse tubercle; upper surface shining, very remotely impressed with minute punctures; lateral margin longitudinally concave. Apex of scutellum rounded. Elytra broader than the thorax, oblong, convex, their lateral margin narrowly dilated, reflexed.

Hyphasis Bevani.

H. ovata, convexa, nitida, subtus fulva, metapectore, femoribus posticis apice tarsisque posticis piceis; supra rufo-fulva, antennis (basi excepta) nigris; thorace evidenter, subremote punctato; elytris subcrebre punctatis, obscure viridi-æneis, limbo exteriore anguste rufo.
Long. 1¼ lin.

Hab. Southern India. Collected by Lieut. Bevan.

Head trigonate; vertex and front smooth, impunctate; inner orbit of eye coarsely punctured; encarpæ well defined, separated from the front by a transverse groove, subtrigonate, contiguous; carina linear, its apex thickened, obtuse; antennæ with the two lower joints fulvous, the following two piceous, the rest black; labrum and apex of jaws piceous. Thorax nearly three times as broad as long; sides obliquely rounded and converging from base to apex, the anterior angle thickened, broadly and obtusely truncate, oblique, produced laterally into an acute tooth; upper surface transversely convex, distinctly punctured; lateral margin moderately dilated, reflexed. Scutellum trigonate, its apex obtuse, edged with black. Elytra oblong, broader than the thorax, convex, rather strongly and closely punctured; obscure metallic green, the outer limb very narrowly edged with rufous; inflexed

limb slightly concave, its outer edge scarcely produced. Prosternum oblong-quadrate, the lateral margins concave, the apex truncate, the upper surface nearly plain; outer edge of hinder tibiæ serrulate near the apex; basal joint of hinder tarsus longer than the following two united.

This species differs from the typical form of the genus in its broader prosternum, and in the less strongly produced outer edge of the inflexed limb of the elytra.

Œdionychis Mouhoti.

Œ. elongato-ovata, modice convexa, sordide flava, nitida, pectore piceo; vertice scutelloque nigris; thorace ante basin leviter transversim impresso, tenuissime, remote punctato, lateribus late reflexo-explanatis; elytris sat fortiter, crebre punctatis, utrinque linea suturali maculisque tribus disco exteriore longitudinaliter positis, prima super callum humerale, basi adfixa, secunda prope medium tertiaque ante apicem, nigris.

Var. **A. pectore sordide flavo, elytrorum linea suturali nigra obsoleta.**

Long. 3 lin.

Hab. Siam, Pachybouri. Collected by the late M. Mouhot.

Vertex minutely punctured, front impressed with large round foveolate punctures; encarpæ subquadrate, contiguous; carina short, wedge-shaped, its acute apex extending upwards between the encarpæ for rather more than a third their length, its base terminating on a strongly raised transverse ridge, which extends obliquely on either side entirely across the clypeus; antennæ filiform, the third and fourth joints equal. Thorax three times as broad as long; sides broadly dilated, reflexed, straight and parallel for two thirds their length, rounded and converging near the apex, the latter anteriorly produced, armed at its extremity with a slightly excurved, truncate tooth; basal margin sinuate on either side near the outer angle, the intermediate space truncate; upper surface impressed before the base with a broad but shallow transverse groove; minutely and remotely punctured; lateral margin longitudinally concave. Scutellum trigonate, its apex rounded. Elytra rather broader than the thorax, convex, the outer margin moderately dilated, reflexed.

Œdionychis pretiosa.

Œ. ovata, convexa, nitida, subtus nigro-picea, lateribus flavis; supra fulva, vertice, antennis, pedibus posticis scutelloque nigris; thorace impunctato; elytris subcrebre punctatis, metallico-cyaneis, vio-

laceo micantibus, utrinque macula prope medium limboque inflexo flavis.

Var. A. elytrorum maculis discoidalibus flavis obsoletis.

Long. 2¾ lin.

Hab. Brazil, New Friburg.

Vertex strongly but not very closely punctured, shining black; lower face, together with the inner orbit of the eye, obscure fulvous, encarpæ and carina piceous; encarpæ separated from the front by a deep transverse groove; carina oval; antennæ with the three lower joints obscure piceous, the rest black, third joint shorter than the fourth. Thorax with its sides broadly margined, reflexed, nearly straight and parallel behind the middle, thence slightly rounded and converging to the apex, anterior angles produced anteriorly, thickened, obtuse; basal margin slightly bisinuate on either side, the median portion opposite the base of the scutellum also slightly sinuate; upper surface shining, nearly impunctate, longitudinally excavated on the reflexed lateral margin, obsoletely elevated on either side just to within the latter, the middle portion of both the apical and basal margins narrowly edged with black. Scutellum subtrigonate, its apex rounded, depressed. Elytra broader than the thorax, broadly ovate, moderately convex, longitudinally depressed along the base of the suture, distinctly punctured; inflexed limb flavous. Basal joint of hinder tarsus much shorter than the following two united.

Œdionychis porosa.

Œ. ovata, convexa, nitida, nigra, facie inferiore fulvo-picea, thorace flavo; elytris irregulariter foveolatis foveis fundo punctatis, cyaneis, limbo laterali (apice dilatato) flavo.

Var. A. elytris nigris, limbo laterali trienteque apicali flavis.

Var. B. ♂ thorace nigro, lateribus anguste flavis, elytris nigro-æneis, limbo exteriore anguste flavo.

Long. 3½–4 lin.

Hab. Ecuador. Collected by Mr. Buckley.

Front with a deep cruciform depression; on either side near the eye are three or four deep round punctures; the upper surface of the three lower joints of antennæ piceo-fulvous. Thorax with its sides broadly reflexed, parallel at the base, thence rounded and converging to the apex, anterior angles produced into a short obtusely truncate tooth; upper surface minutely punctured. Scutellum trigonate, its apex obtuse. Elytra moderately convex, their apical margin finely serrulate; closely covered with irregular punctured foveæ, their interspaces thickened, irregularly confluent, shining, impunctate.

Œdionychis limbata.

Œ. elongato-ovalis, modice convexa, dorso subdepressa, subtus sordide albido-flava, prosterno, genibus, tibiis tarsisque nigro-piceis; supra nigra, antennarum articulis basali necnon ultimis quatuor piceis; facie, thoracis lateribus latis elytrorumque limbo exteriore lato albido-flavis; prosterno inter coxas longitudinaliter elevato. Long. 3½ lin.

Hab. Ecuador.

Vertex and front smooth, impunctate; lower portion of front depressed, separated from the encarpæ by a transverse grooved line; encarpæ large, quadrangular, slightly oblique, contiguous; carina strongly raised, elongate; antennæ filiform, the third and fourth joints equal; labrum and jaws piceous; eyes large, prominent. Thorax with its sides very broadly margined, reflexed, slightly converging at the extreme base, rounded and converging before the middle to the apex, the anterior angles thickened, produced anteriorly into a slightly excurved, obtusely truncate tooth; basal margin very faintly sinuate on either side close to the outer angle, the intermediate space transversely truncate; upper surface very faintly impressed transversely in front of the base, very minutely punctured; lateral margin longitudinally excavated. Scutellum trigonate, its apex obtuse; on the disk near its apex is a piceous spot. Elytra broader than the thorax, oblong, moderately convex, slightly depressed along the suture, the lateral margin broadly dilated, its outer edge slightly reflexed; surface rather closely punctured, interspaces subrugulose. minutely punctured.

Œdionychis circumcincta, Dej.

Œ. late ovata, convexa, flava, nitida, antennis (basi excepta) nigris; thorace lævi, lateribus late explanatis, subruguloso; scutello nigro; elytris crebre, fortiter punctatis, interstitiis granulosis, crebro rugulosis.

Var. A. elytris metallico-viridibus, limbo externo flavo.

Var. B. elytris rufo-testaceis, limbo externo flavo, fascia basali communi, extrorsum abbreviata, vittaque submarginali, a basi ad apicem extensa, metallico-viridibus.

Long. 4–6 lin.

Hab. Brazil.

Vertex smooth, impunctate; front very sparingly impressed with round punctures, its lower end depressed, separated from the encarpæ by a transverse groove; inner orbit of eye irregularly punctured; encarpæ transverse, contiguous above; carina broad, its apex acuminate, separating the lower portion of the encarpæ, its lower end terminating in a strongly

raised transverse ridge which extends entirely across the clypeus; jaws piceous; antennæ filiform, two lower joints flavous, the third piceous, the rest black; third joint distinctly shorter than the fourth. Thorax with its sides broadly margined, reflexed, straight and parallel from the base to beyond the middle, thence rounded and converging to the apex, anterior angles thickened, produced into a short excurved obtuse tooth; basal margin faintly sinuate on either side, its median portion truncate; upper surface smooth and shining, very faintly reticulate-granulose; surface of dilated lateral margin irregular, subrugulose. Scutellum trigonate, its apex obtuse. Elytra broader than the thorax, convex, slightly excavated on the suture, a short distance below the scutellum; coarsely and closely punctured, interspaces irregularly thickened, granulose.

Œdionychis recticollis.

Œ. elongato-ovata, postice vix ampliata, convexa, subtus picea, abdomine sordido fulvo, prothorace lacteo; supra lactea, scutello pallide piceo, antennis (basi picea excepta) oculisque nigris; thorace impunctato, lateribus rectis, a basi ad apicem convergentibus; elytris tenuissime, subremote punctatis, utrinque plagis duabus erosis, una infra basin transversim ovata, altera inter medium et apicem transversa, irregulari, nigro-piceis ornatis.

Long. 4 lin.

Hab. Mexico.

Vertex smooth, impunctate; front impressed with coarse punctures; encarpæ ill-defined, pale piceous, separated from each other by a deep longitudinal groove; carina broad, oblong, convex, its apex obtuse, branching off on either side into a strongly raised oblique ridge; lower edge of clypeus and mouth nigro-piceous; eyes narrowly oval, their inner side sinuate; antennæ filiform, two lower joints piceous, the rest black; third and fourth joints nearly equal in length. Thorax twice as broad as long; sides narrowly margined, straight, converging from base to apex, anterior angle thickened, strongly produced, its apex subacute; basal margin slightly sinuate on either side near the outer angle, the intermediate space transversely truncate; upper surface smooth, impunctate, lateral margin narrowly reflexed. Scutellum longer than broad, trigonate, its apex obtuse. Elytra broader than the thorax, narrowly oblong, moderately convex, the lateral margin narrowly dilated.

Œdionychis Clarkii.

Œ. elongato-ovata, modice convexa, pallide flava, nitida; thorace

læevi, maculis nigro-piceis quinque notato, harum tribus pone apicem, linea transversa conjunctis, macula intermedia ad marginem adfixa, duabusque transversis, ad basin utrinque adfixis; elytris subcrebre punctatis, punctis leviter impressis, pallide piceo tinctis; singulis linea suturali angusta, ante apicem abbreviata, punctisque tribus, uno super callum humeralem, altero infra basin prope suturam, tertioque prope medium disci positis, nigro-piceis.

Long. 4 lin.

Hab. Brazil, Constancia. Collected by the late Rev. H. Clark.

Face elevated between the eyes, the latter large, prominent; vertex and front granulose, impressed with large, irregular shallow punctures; encarpæ large, well defined, quadrate, contiguous; carina linear, strongly elevated; inner orbit of eye bounded by a row of irregular punctures; antennæ filiform, third and fourth joints equal. Thorax with its sides broadly margined, reflexed, rounded and converging from base to apex, the anterior angles thickened, produced anteriorly, subacute; the hinder angles produced into a short subacute tooth; basal margin sinuate on either side, the median portion also sinuate in front of the scutellum; upper surface nitidous, very finely strigose, lateral margin longitudinally concave. Scutellum trigonate, its apex subacute. Elytra broader than the thorax, narrowly oblong, subacutely rounded at the apex, the apical margin obsoletely crenulate; above moderately convex, impressed with round, shallow, pale piceous punctures, paler and less deeply impressed towards the apex, their interspaces finely granulose, faintly wrinkled; each elytron with a narrow sutural line, abbreviated before the apex, and three small spots, nigro-piceous; of these the first is placed on the upper portion of the humeral callus, the second on the inner disk, halfway between the callus and the suture, slightly lower than the former one, and the third on the middle of the elytron, about halfway between the suture and the lateral margin.

Œdionychis rugiceps.

Œ. ovata, convexa, nigra, nitida, thorace flavo-albo, linea basali, utrinque abbreviata, maculisque novem, 2 super marginem apicalem, 4 disci vix ante, 2 vix pone medium transversim positis, necnon una ante basin, nigris; elytris subopacis, margine exteriore, vitta discoidali, apice ad marginem adfixa, fasciaque obliqua subapicali inter limbum et vittam extensa, nitide flavo-albis.

Long. 3 lin.

Hab. Brazil, Parana.

Head coarsely rugose; encarpæ and carina ill-defined, the lower end of the latter terminating on a strongly raised transverse ridge; antennæ scarcely half the length of the body, moderately robust, thickened towards the apex, entirely black; third and fourth joints nearly equal in length. Thorax nearly three times as broad as long; sides broadly margined, reflexed, straight and parallel, rounded and converging before the middle, anterior angles produced, thickened, obtuse; basal margin slightly oblique and faintly sinuate on either side near the outer angle, the latter produced, acute; intermediate space obtusely truncate, narrowly edged with black; disk finely granulose, nitidous, sparingly punctate; lateral margin concave, the outer edge thickened. Scutellum trigonate, rather broader than long, its apex obtuse. Elytra broader than the thorax, oblong-ovate, moderately convex, finely granulose-punctate, subopaque; the white marking nitidous, finely punctured.

Œdionychis nigro-lineata.

Œ. ovata, modice convexa, nitida, subtus piceo-nigra, prothorace abdominisque limbo exteriore sordide fulvis; supra sordide fulva, vertice, scutello antennisque (harum articulis basalibus tribus piceis exceptis) nigris; thorace lævi, tenuiter, remote punctato, maculis quinque, 2 et 3 dispositis, nigro-piceis notato; elytris evidenter, subcrebre punctatis, utrinque linea suturali, vitta submarginali, apice cum linea suturali conjuncta vittaque discoidali, a basi fere ad apicem extensa, nigris.

Long. 2½ lin.

Hab. Brazil, Bahia.

Vertex smooth, nearly impunctate, lower portion of front coarsely punctured; encarpæ subquadrangular, separated from the front by a deep longitudinal groove; antennæ robust, second and third joints nearly equal in length; labrum and jaws obscure piceous. Thorax with its sides broadly margined, straight and nearly parallel behind the middle, thence rounded and converging to the apex, anterior angles armed with a slightly excurved, obtuse tooth; upper surface nitidous, remotely and finely punctured, lateral margin reflexed. Scutellum trigonate; its apex obtuse, piceous. Elytra rather broader than the thorax, oval, moderately convex, much more strongly punctured than the thorax; lateral margin narrowly reflexed; inflexed limb obscure fulvous, its inner edge nigro-piceous. Anterior border of prosternum deflexed. Basal joint of hinder tarsus nearly equal in length to the following two united.

Œdionychis Chevrolatii.

Œ. late ovata, convexa, nitida; subtus, cum capite (encarpis flavis exceptis), nigra, abdomine piceo, margine externo segmentorumque marginibus pallidioribus; supra flava; thorace lævi, impunctato; scutello trigonato, nigro; elytris sat remote, tenuiter punctatis, utrinque vitta suturali, altera submarginali, his apice conjunctis, tertiaque discoidali, paullo ante apicem abbreviata, nigro-cyaneis; limbo exteriore angusto piceo.

Long. 3 lin.

Hab. Mexico.

Vertex smooth, impunctate; inner orbit of eye and the upper surface of the front impressed with large, round punctures; lower portion of front very finely strigate; encarpæ separated from the front by a distinct transverse groove, subquadrangular, pale fulvous; carina strongly elevated; second and third joints of antennæ nearly equal in length. Thorax three times as broad as long; sides nearly straight, very slightly converging behind the middle, thence converging and slightly rounded to the apex; anterior angles mucronate; basal margin bisinuate on either side, the median portion not produced, obtusely truncate; upper surface shining, impunctate; lateral margin broadly reflexed. Scutellum trigonate, its apex acute. Elytra broader than the thorax, increasing in breadth from the base towards the apex, the latter broadly rounded; above moderately convex, longitudinally excavated along the base of the suture, the depressed surface rather strongly and coarsely punctured.

[To be continued.]

XXXVI.—*Studies on the Hydroida.* By C. Mereschkowsky.

[Continued from p. 256.]

III. *Systematic Facts.*

As I am now busy preparing a complete description of all the Hydroids occurring in the Russian seas, which will shortly appear in my native language, I shall here give simply a list of the species which I have met with in my two visits to the White Sea, and only describe a few of the new species and the new genera. The deficiency of material in respect of Hydroids in our zoological museums sometimes renders the determination of the species very difficult, and in some cases rather doubtful; for frequently it is very desirable to compare two specimens, one of which is already determined. But I

hope to be able to procure in England specimens of the most desirable species in exchange for my own, which will enable me to verify my determinations. At any rate, I shall attach a note of interrogation to any species that is in the least degree doubtful. The species are as follows:—

Suborder ATHECATA.

1. *Oorhiza borealis*, nov. gen. et nov. sp.
2. *Hydractinia*, sp. indet.
3. *Syncoryne Sarsii*: Medusæ (*Sarsia tubulifera*) in great numbers.
4. *Stauridium productum*.
5. *Eudendrium arbuscula* (?), S. W.
6. *E. minimum*, nov. sp.
7. *Bougainvillia paradoxa*, nov. sp.: the Medusæ only in very large numbers.
8. *Monobrachium parasitum*, mihi (see Ann. & Mag. Nat. Hist., September 1877).
9. *Tubularia simplex*.
10. *T. indivisa*.

Suborder THECAPHORA.

11. *Obelia geniculata*, Linn.
12. *O. gelatinosa* (?), Pall.
13. *O. flabellata*, Hincks.
14. *Campanularia volubilis*, Linn.
15. *C. integra* (?), Macgillivray.
16. *C. verticillata*, Linn.
17. *C. neglecta*, Alder.
18. *Leptoscyphus Grigoriewi*, nov. sp.
19. *Lafoëa dumosa*, Sars.
20. *L. pocillum*, Hincks.
21. *Calycella syringa*, Linn.
22. *Cuspidella*, sp. indet.
23. *Salacia abietina*, Sars.
24. *Filellum serpens*, Hassall.
25. *Coppinia arcta*, Dalyell.
26. *Halecium Beanii* (?), Johnst.
27. *Halecium*, sp. indet.
28. *Sertularella gigantea*, mihi, = *S. polyzonias*, robust variety, of Sars and Hincks.
29. *S. tricuspidata*, Alder.
30. *S. rugosa*, Linn.
31. *Diphasia*, Agass., sp. indet.
32. *Sertularia pumila*, Linn.
33. *S. filicula*, Ellis & Sol.

34. *S. abietina*, Linn.
35. *S. argentea*, Ellis & Sol.
36. *S. albimaris*, nov. sp.
37. *Hydrallmania falcata*, Linn., var. ***bidens***.
38. *Thuiaria thuja*.
39. *T. articulata* (?).
40. *Polyserias mirabilis*, Verrill.
41. *P. Hincksii*, nov. gen. et nov. sp.

Suborder GYMNOCHROA.

42. *Hydra oligactis*, in the fresh water of the isle of Solovetzky.

It will be seen that among the forty-two species there are about eight which are new; the Hydroid fauna of the White Sea is therefore a rather peculiar one. Besides this we also see that as regards its fauna the White Sea belongs to regions which are quite polar, more polar, in fact, than the north of Norway and even the Mourmansky bereg (north of Lapland). Thus, while the White Sea has no representative of the family Plumulariidæ, which is characteristic of the southern seas, and, on the other hand, has many representatives of the families Lafoëidæ, Coppiniidæ, and Sertulariidæ, the Mourmansky bereg has furnished magnificent specimens of *Antennularia antennina*, of which the Zoological Cabinet of St. Petersburg is in possession. The Baltic has several species in common with the White Sea; but all these species are represented in England, Germany, or Belgium; they have consequently been able to arrive there through the Cattegat and Skagerrack, without its being necessary to explain this fact by the assumption of a union between the two seas; so that, as far as the Hydroids are concerned, they do not present any facts in support of Lovén's hypothesis, which, moreover, has been much shaken by the investigations of Prof. O. Grimm, of St. Petersburg*. Lastly, on comparing this fauna with that of the north of the Pacific Ocean, as represented by Mr. Clark, and also by the collection of the Museum of the Academy of St. Petersburg, it will be seen that there are relations between these two faunas. The genus *Polyserias* is especially characteristic of the north of the Pacific (I am acquainted with three species of this genus from the sea of Ochotsk); and, as we see, the White Sea possesses two species, one of which is common (*Polyserias mirabilis*). Further, the presence of *Coppinia arcta*, *Lafoëa dumosa*, *Campanularia integra*, *Lafoëa pocillum*,

* O. Grimm, 'On the Fauna of the Baltic Sea and its Origin' (in Russian), 1877.

Calycella syringa, several *Sertulariæ*, *Sertularella rugosa* and *tricuspidata* proves that the fauna of the White Sea is only a special department of a circumpolar fauna.

From what we now know of the distribution of the Hydroids it may be seen that, in fact, there exists such a circumpolar fauna, on the one hand perfectly special, and on the other represented by species which also occur in Europe, in England, the Baltic, &c. It is always easy to recognize to which fauna a species must belong, from a consideration of its size: in its native place, in the country from which it started, the species will certainly appear in all its splendour and of its largest size; for it is there especially that the conditions of life are most favourable to it. Thus, among the Hydroids there are certain species which frequently occur in the north (Iceland, Greenland, Spitzbergen, &c.), and which are there distinguished from the same species obtained from England, for example, by their excessive size. It is clear, therefore, that the polar regions must be regarded as the native place of these species, as the starting-point from which they have spread southwards into warmer seas, which certainly must have had an effect upon them, rendering them feebler; and it is in this that I find the answer to the question raised by Hincks*, as to why this phenomenon is observed. But, on the other hand, it must not be forgotten that in the family Plumulariidæ there are species characteristic of the southern seas of gigantic size, as, for example, that described by M. Semper†, which proves that the native place and starting-point of all these Hydroids must be regarded as in southern regions; and it is very probable that the further to the north they are met with, the weaker and poorer they will be.

I will now pass to the descriptions of new Hydroids.

OORHIZA, nov. gen. (Pl. XV. figs. 7–11.)

Hydrorhiza a continuous layer consisting of a mass of anastomosing tubes, covering the shells of Gasteropods. From its surface rise spines and sexual and nutritive individuals. Trophosome cylindrical, with a single whorl of filiform tentacles. The sporosacs rise directly from the hydrorhiza, without the intervention of blastostyles.

As will be seen from the character of this genus, it must undoubtedly be placed in the family Hydractiniidæ, which appears at once from the habit of this Hydroid. The continuous layer of the hydrorhiza, the spines, and the long and

* Ann. & Mag. Nat. Hist. 1874, vol. xiii. p. 147.
† Zeitschr. für wiss. Zool. vol. xiii. p. 560.

slender hydranths, all unmistakably recall a *Hydractinia* or a *Podocoryne*; so that from the trophosome alone it is impossible to distinguish *Oorhiza* from one of the above-mentioned genera. But the sexual individuals (gonosomes) present such characteristic peculiarities that it is impossible to place the Hydroid in question in any of the known genera of Hydractiniidæ. *Podocoryne*, as is well known, has the gonosomes consisting of blastostyles upon which Medusæ are produced; *Hydractinia* differs in that the same blastostyles give origin to sporosacs; lastly, *Oorhiza* has no blastostyles at all, but the sporosacs rise from the hydrorhiza itself.

It is true that in *Podocoryne* the presence of the blastostyles is not a constant character: their absence, indeed, is constant in *Podocoryne areolata*; in others, as for example *Podocoryne aculeata*, there may or may not be a blastostyle; and, finally, in *Podocoryne carnea* the Medusæ are constantly produced upon blastostyles. But this does not apply to the genus *Hydractinia*, in which the presence of blastostyles is a perfectly constant character and essential to the genus.

The genealogical relations between the genera and species of the family Hydractiniidæ may be expressed by the accompanying diagram:—

echinata. *polyclina.*

Hydractinia *Oorhiza borealis.* *P. areolata.* *P. carnea.*

Intermediate form*. *Podocoryne aculeata.*

* This hypothetical intermediate form must have existed *analogically* with *Podocoryne aculeata*; it must have possessed indifferently sporosacs on blastostyles and without blastostyles: on one side *Hydractinia* was developed (analogically with *Podocoryne carnea*); on the other *Oorhiza* (analogically with *P. areolata*). If ever this hypothetical form is found, it will be necessary to unite the genera *Hydractinia* and *Oorhiza* into a single one, or else to establish a distinct genus for *Podocoryne aculeata*, which can by no means be done.

Oorhiza borealis, nov. sp. (Pl. XV. figs. 7–11.)

Trophosome.—The continuous layer of the hydrorhiza is furnished with fine spines in the form of elongated cones. The body of the hydranth, of a pale rose- or flesh-colour, has the form of an elongated cylinder. The number of tentacles varies from six to ten; their length is not equal, in consequence of different states of contraction.

Gonosome.—The gonozooids are placed very close together and in great numbers, and in consequence of their spherical form give the surface of the hydrorhiza a tuberculose aspect. Each gonozooid consists of a short spadix rising directly from the hydrorhiza, and a single ovum placed at the extremity of the spadix.

Locality.—The neighbourhood of the island of Solowetzky, at a depth not greater than 10 fathoms.

The spadix widens at its upper extremity; and it is upon this dilated part that the ovum is placed, as if upon a plate (fig. 8). A single spadix never bears more than one ovum, which may be of different sizes, sometimes very considerable, which proves that the ovum may grow up to a certain point—after which the absorption of nourishment changes the process of growth into a process of multiplication; the segmentation of the ovum commences. In the granular contents of the ovum a pale nucleus is always observed, and frequently a nucleolus. It would appear from M. Wagner's drawings that the ovum is surrounded by a layer of ectoderm (Pl. XV. fig. 8), the same ectoderm that covers the spadix, so that the ovum is placed between the ectoderm and the endoderm. The number of tentacles is very variable; but the numbers most frequently met with are those produced from 2, such as 6, 8, and 10, which leads us to regard 2 as the fundamental number of the Hydroids (fig. 7).

The tentacles of *Oorhiza borealis* present facts of very great importance. Their surface at the end (Pl. XV. fig. 11) is not smooth; it is mamillated, and the mamillæ give origin to something like secondary tentacles, or, rather, like pseudopodia. They consist of short, but not very fine, colourless, transparent, structureless cylinders, which spring from the surface of the mamillæ usually in groups of three or four together. These pseudopodia move very slowly; and M. N. Wagner has seen them issue and disappear just as in the *Amœbæ*. Moreover he has seen issuing from the surface, but also very slowly, larger and thicker protuberances, which became more and more rounded and inflated, and at the same time became constricted, so that they remained attached to

the tentacle only by a very thin peduncle (Pl. XV. fig. 10). In the interior there was to be seen a yellowish mass, the nature of which could not be ascertained by M. N. Wagner. At the same time the surface of this little sphere or protuberance gave origin in its turn to cylindrical pseudopodia, exactly of the same kind as those which were produced by the surface of the tentacles. These protuberances move slowly, and are put forth and disappear under the eyes of the observer. M. N. Wagner has communicated to me the interesting fact that, on making thin sections across the brain of the frog, previously hardened by freezing, it has been observed under the microscope that after the nervous substance was thawed, it began to move after the fashion of the *Amœbœ*, and thus changed its place, just in the same way as the protuberances of *Oorhiza* which I have just described. M. N. Wagner thinks that there is an analogy between these two facts, and supposes that these protuberances may be of a nervous nature, although certainly but little differentiated.

In one of the ends of tentacles of *Oorhiza* figured by M. Wagner, I observe the presence of pigment dispersed in the form of red granules of different sizes among the trichocysts (Pl. XV. fig. 9). The presence of these in a spot to which they could not be conveyed by the current of digestive fluid (they are placed principally close to the surface of the end of the tentacle), as also their habit, which greatly reminds us of the pigments which are met with in the eyes of the Medusæ (e. g. *Syncoryne Sarsii*), leads me to believe that we really have to do here with the first commencement of the organ of sight, which certainly could hardly choose a better place than the tips of the tentacles. This explanation of the pigment in question is placed absolutely beyond doubt and has become a proven fact for every one who has read the brilliant article, "Die Organ-Anfänge: I. Seh-Organ," by M. G. Jäger, which appeared in the second part of the new German periodical 'Cosmos' *. M. Jäger treats the question of the forms under which the organs of sight must appear in the animal kingdom, and proves with marvellous clearness that the first indications of these organs must consist in a part of the protoplasm becoming pigmented (red, green, &c., and subsequently black), which retains the light and transforms the molecular movement produced by it into sensation of light, while the non-pigmented protoplasm, allowing all the light to pass through it, cannot feel the sensation of light. Thus not

* Cosmos: Zeitschrift für einheitliche Weltanschauung auf Grund der Entwickelungslehre in Verbindung mit Ch. Darwin und E. Häckel, 1877, May, p. 94.

only the Medusæ, but also the Hydroids, possess organs of sight.

Oorhiza is always seated upon the shells of Gasteropods, especially *Buccinum undatum* and *Fusus despectus*, in large colonies, near the island of Solowetzky, most frequently at a depth of 5–8 fathoms.

Prof. M. Wagner, who first found, examined, and figured it, has most kindly furnished me with all his facts and drawings, some of which are represented in Pl. XV. It is from these drawings that I have prepared the description of the Hydroid.

Leptoscyphus Grigoriewi, nov. sp. (Pl. XIV. figs. 1, 2.)

A small branching colony. The branches which bear the hydrothecæ with their pedicels are regularly and slightly angularly bent and slightly ringed, especially above each angle. The pedicels which support the hydrothecæ are short, never exceeding half the length of the hydrotheca, and are much more strongly ringed than the branches. They are very regularly arranged alternately upon the branches, and always issue from the angle formed by the branch. The hydrothecæ are of an elongated form, in the shape of two cones, of which the inferior is the larger, and the upper, smaller one is divided into lobes, which form an operculum; this division is not deep, never exceeding $\frac{1}{3}$ of the length of the whole hydrotheca.

The gonophores are unknown.

Locality.—The colonies were found seated upon an Ascidian which is very widely distributed in the White Sea, in the Bay of Onega, at the mouth of the river Kem, in 34° 55′ of longitude, at a depth of 5 fathoms, on a muddy bottom, July 5, 1875.

The position that I have assigned to this Hydroid, in the genus *Leptoscyphus*, is only provisional; it might equally well be placed in the genus *Campanulina*, which only differs from *Leptoscyphus* in the gonophores, with which I am unacquainted here. In regard to its specific distinctness, there can be no doubt that the Hydroid in question constitutes a new species, which I have called *Leptoscyphus Grigoriewi*, in honour of my travelling companion, the botanist, A. W. Grigoriew.

This species is distinguished principally by the form of the hydrothecæ, which have the segments of the superior cone not very deep, usually less than one third of the total length of the hydrotheca. This distinguishes it from *L. tenuis*, Allman, with which it has many resemblances. The lower part of the hydrotheca narrows regularly (Pl. XIV. fig. 2, *b*);

but frequently individuals are met with in which this part diminishes very little, and thus acquires a nearly cylindrical form (Pl. XIV. fig. 2, *a*). Another characteristic feature is the shortness of the pedicels which support the hydrothecæ, and which are a little less than half the length of the hydrotheca, whilst in *L. tenuis* the pedicel is longer than the hydrotheca. The annulation is pretty well marked, but far from attaining the development observed in *Campanulina repens*, which is further distinguished from *Leptoscyphus Grigoriewi* by the mode of ramification and the form of the hydrotheca. In our species the annulation is clearly marked only in the pedicels, and on the branches above the points of insertion of the latter. The colour of the branches is especially distinct at the base of the colony, where it is a dull brown; it becomes lighter and lighter towards the middle, and finally disappears at the extremity. The hydrothecæ are always colourless.

Length of the hydrothecæ (average) 0·34 millim., length of the superior cone 0·1, maximum breadth of the hydrotheca 0·091, length of the pedicel 0·15, breadth of the branches 0·065.

Sertularella gigantea, mihi. (Pl. XIV. figs. 6, 7.)

Sertularia polyzonias, Linn., var *robusta*, Sars, "Bidrag til Kundskaben om Middelhavets Litoral-Fauna," in Nyt Magazin for Naturvidenskaberna, 1857, p 163.

Sertularia polyzonias, Linn., *polyzonias* (ex parte), Hincks, Hist. Brit Hydr i p. 235.

Sertularia polyzonias, Linn., var. *gigantea*, Hincks, "On Deep-water Hydroida from Iceland," Ann & Mag. Nat. Hist. ser. 4, vol. xiii. (1874), p. 151, pl. vii. figs. 11, 12.

Sertularia polyzonias, Linn., var. *gigantea*, Hincks, S. Smith and O. Hagen, "Report on the Dredgings in the Region of St. George's Banks in 1872," Trans. Conn. Acad. of Arts and Sciences, iii. part i. (1876), p. 53.

The tolerably flexible stems spring from the branched hydrorhiza often without ramifying; sometimes they divide at their base into two or three branches, each of which may again ramify once more; the terminal branches are in all cases very long and straight. The hydrothecæ are evidently alternately arranged upon the angularly bent stem; frequently we observe three or four undulations (ribs) crossing the hydrotheca; its form is much elongated, only a little widened at its base; in size it is two or three times the length of the hydrotheca of *S. polyzonias*. In adult individuals the margins are always furnished with several ledges, and an equal number of small opercula placed one above the other. Below each hydrotheca the stem is slightly ringed.

Gonophores unknown.

Localities.—1. Island of Solowetzky, on a *Balanus* (depth unknown); 2. Not far from the Orlow promontory, 67° 17′ N. lat. and 41° 35′ E. long., at a depth of 35 fathoms on a gravelly bottom, attached to *Flustra* (June 28); 3. Glacial sea, Mourmansky bereg, Gaurilowo, Stanowischtjé (from M. Danilewsky, in the collection of the Museum of the Academy of Sciences of St. Petersburg).

This species has long been known; but M. Sars and Mr. Hincks have regarded it as simply a polar variety of *Sertularella polyzonias*. Nevertheless, even by its appearance to the naked eye, by the habit, it is always very easy to distinguish this species from every other species of the genus *Sertularella*; and this distinction is produced principally by the enormous hydrothecæ, which are often twice the length of those of *S. polyzonias*. And besides all this, it must be taken into consideration that, among all the Hydroids of my collection, I do not find a single one that presents a form intermediate between *S. polyzonias* and *S. gigantea*, which I possess from three different localities. Hence this character is very constant, and is characteristic of the northern seas. Neither Mr. Hincks, nor M. Sars, nor MM. Smith and Hagen say a single word as to intermediate forms; so that I am led to regard the var. *gigantea* of *S. polyzonias* as a distinct species, as constant as any other, and having characters sufficiently salient to enable it to be recognized with facility. Besides its size, this species is further characterized by the form of the hydrothecæ, which are much elongated and often have three or four ribs, by the margin, which is always adorned with several (sometimes eight or even ten) ledges, giving it a very peculiar aspect, and, lastly, by the mode of ramification. All this will be better understood from figs. 6 and 7 of Plate XIV., especially if these drawings be compared with that of *S. polyzonias* given by Hincks*.

Usual length of the colony 3–4 centims. Length of the hydrotheca 1·3 millim., its breadth 0·52; space between two successive hydrothecæ along the stem 0·63.

Sertularia albimaris, nov. sp. (Pl. XIV. figs. 3–5.)

Hydrorhiza composed of a continuous layer, produced by the confluence of an ordinary ramified hydrorhiza in a single plane; so that the thickness of the layer does not exceed the diameter of the tubes of the hydrorhiza. The surface of this

* Hincks, Hist. of Brit. Hydr. pl. xlvi. fig. 1. I have *Sertularella polyzonias* from the Black Sea; so that I have been well able to compare the two species; and it is strange that Mr. Hincks did not find it possible to separate these two very different forms.

layer is furnished with small spines. The principal stem is very wide; it gives origin to slenderer branches, arranged alternately and regularly in a single plane, so that the whole acquires the aspect of a feather. The lateral branches may divide dichotomously at their extremities. The position of the hydrothecæ is not exactly opposite; their form is not very characteristic; the summit is a little compressed and notched, so as to form two points.

Gonophores unknown.

Locality.—The narrow part of the White Sea (Gorlo), between the river Ponoy and the island of Morjowetz, in 66° 55′ N. lat. and 40° 45′ E. long., at a depth of 20 fathoms, on a gravelly bottom (June 28, 1876)?. I am not quite sure that the ticket attached to this Hydroid is the right one.

This is undoubtedly one of the most singular and interesting species of the genus *Sertularia*; and, indeed, if the differences presented by the hydrorhiza are increased by those of the gonophores, it will be necessary to form a distinct genus for it. What most characterizes it is the hydrorhiza, which is composed of a rather thin layer, giving origin at its surface to several colonies in the form of pretty bushes, so that the whole resembles a little shady thicket. Under the microscope it is seen that the hydrorhiza is adorned with an irregular branching pattern, formed by partitions which are nothing but the lateral walls of the tubes of the hydrorhiza, which has become a continuous layer by means of these walls (Pl. XIV. fig. 5). This is the reason why we always notice that the partitions seen in profile have a line in the middle, which is caused by these partitions being formed by two lateral walls belonging to two neighbouring tubes, which are thus united. Both the upper and lower layers of chitine, between which the partitions are placed, are nothing but the upper and lower walls of the original tubes. Thus we see that the hydrorhiza is formed of several ramified tubes, which have become fused together by their lateral walls; these lateral walls, after having joined in growing, form the pattern already mentioned (figs. 5, 6), whilst the upper and lower walls constitute the upper and lower continuous membranes, between which the pattern is placed. There are spots at the margin of the hydrorhiza where this process is still continuing; and here it may all be seen perfectly.

So far as I know, there is not a single species, not only in the whole family Sertulariidæ, but generally among the Thecaphora, that has a hydrorhiza of this kind, which much resembles the hydrorhiza of *Hydractinia* or *Podocoryne*, but with the difference that in these latter the hydrorhiza is composed

of several layers superposed upon one another, whilst in *Sertularia albimaris* it only consists of a single layer.

As I have already said, the surface of the hydrorhiza bears processes of chitine in the form of long, slender cones, empty in the middle and without openings at the extremity (fig. 5, *a*). The length of these conical spines does not exceed 0·2 millim. These cones, which remind us of the spines in *Hydractinia* and *Podocoryne*, are not numerous. It is a very interesting fact that, in all the cases in which the hydrorhiza assumes the form of a continuous layer, this peculiarity is always combined with another, namely the existence of spines; and it would be interesting to ascertain the wherefore of this characteristic coincidence that exists between these two facts.

Another peculiarity presented by this Hydroid is that the principal stem (fig. 3) is very wide in one direction (it is compressed); and this width is not induced by the size or breadth of the hydrothecæ, but by the central portion which bears the hydrothecæ, which gives the colony a very peculiar habit. The width of the lateral branches is much less. The hydrothecæ are a little compressed at the end, not, however, in the same direction as the principal stem, but in a direction perpendicular to this; and their orifice is notched so as to form two teeth. In general form they remind us of those of *Polyserias mirabilis*. Sometimes, however, hydrothecæ occur with very elongated necks bent to one side. Two or three pairs of hydrothecæ (sometimes, especially on the principal stem, a single pair) form an articulation which may easily be detached. The position of the hydrothecæ is more or less opposite, more alternate on the lateral branches than on the principal stem; but even then it is easy to group them in pairs; so that, according to M. Kirchenpauer, it would be necessary to arrange this species in the genus *Dynamena*; but, considering the insignificance and the want of clearness of this distinction, I prefer to retain the English terminology.

Length of the colony 16 millims.; breadth of the principal stem (measured between the outermost summits of two opposite hydrothecæ) 0·8, the same breadth in the lateral branches 0·60–0·73; length of the hydrothecæ 0·43, their breadth 0·17; length of the spines 0·2.

Polyserias, nov. gen.

This genus, belonging to the family Sertulariidæ, forms a very peculiar type among the Hydroids of the order Thecaphora, by reason of the arrangement of its hydrothecæ. Except *Salacia abietina* and *Campanularia verticillata*, there

exists no Thecaphorous Hydroid in which the hydrothecæ are arranged in more than two rows; but even in the above two species the apparent arrangement in several rows is, fundamentally, the result of the stem being composed of as many smaller stems amalgamated together as there are rows of hydrothecæ; so that here the number of rows is only apparent. But in all the Hydroids in which the stems are not complex the hydrothecæ are arranged either in two rows, as in *Sertularia*, *Thuiaria*, &c., or in a single one, as in *Plumularia*, *Aglaophenia*, *Hydrallmania*, &c. In *Polyserias*, on the contrary, although in all other respects it differs but little from *Sertularia* or *Thuiaria*, the arrangement of the hydrothecæ in several (6, 8, 10) longitudinal rows is a character that occurs without the stem being composite. This multiserial arrangement gives a perfectly peculiar aspect to all the species of *Polyserias*: the branches become thick, round, and longitudinally striated; the colonies are usually large, and the branches long. It is characteristic of the whole genus, that on the principal stem the arrangement of the hydrothecæ is, as usual, biserial.

The gonosomes are not very different from the gonophores of *Sertularia* or *Thuiaria*, except that their arrangement may also be multiserial, like that of the hydrothecæ.

When I gave a short description of the genus *Polyserias* in this journal some months ago*, I knew nothing in literature upon this type of Hydroids. Since the publication of my description there has appeared the third part of the 'Proceedings of the Academy of Natural Sciences of Philadelphia,' in which Mr. Clark, in a memoir upon the Hydroids of the Aleutian Islands, describes two species of Hydroids which undoubtedly must be placed in my genus *Polyserias*. Unfortunately the author has not paid sufficient attention to the significance of the multiserial arrangement of their hydrothecæ, and has ranged one of them in the genus *Diphasia*, and the other in *Thuiaria*. It is evident that this view must give place to mine, according to which all the forms should be united in a single genus, *Polyserias*. It was, moreover, only from this memoir that I learned that this polyserial form was described by Mr. Verrill, under the name of *Diphasia mirabilis*, as long ago as 1872, in the 'American Journal,' and subsequently in a Connecticut journal; and I do not think I am mistaken in identifying *Diphasia mirabilis*, Verrill, with my *Polyserias Hincksii* †.

* Ann. & Mag. Nat. Hist., Sept. 1877.

† For the references to these citations see the synonymy of *Polyserias mirabilis*.

Polyserias mirabilis, Verrill. (Pl. XV. figs. 5, 6.)

Diphasia mirabilis, Verrill, Amer. Journ. Sci. vol. v. (Dec. 1872), p. 9; S. Smith & O. Hagen, Trans. Conn. Acad. of Arts & Sci. vol. iii. pt. i. (1877), pp. 219, 225; Clark, Proc. Acad. Phil. 1877, pt. iii. p. 219, pl. xiii. fig. 36.

Polyserias Hincksii, Mereschkowsky, Ann. & Mag. Nat. Hist. vol. xx. (1877) p. 228, pl. vi. figs. 15, 16.

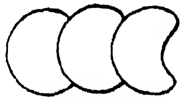
Colony rigid, plume-like, attaining a length of 16 and a breadth of 6 centims. The principal stem is angularly bent, and only bears two series of hydrothecæ; from each angle issues a long and straight branch which is never ramified; the arrangement of the branches is regular, alternate, and in the same plane; they are of equal length to [near] the extremity, where they become shorter. Sometimes, especially in the largest colonies, the stem gives off from its two lower bends, not, as usual, a single branch, but [two or more] branches, which issue simultaneously from the angle formed by the principal stem; and in this very rare case each pair of branches is not arranged in the same plane as all the other branches. Each branch is attached by means of a short peduncle, and forms with the principal stem an angle of about 45°. The hydrothecæ upon the branches are always arranged in six distinct and regular rows, even to the ends of the branches, which terminate abruptly. The transverse section of the branch, if it is rather slender, only shows three cells around the central cavity; but on making the section a little higher up, we obtain three other cells, placed, not directly above the former, but between them in the interstices—which proves that we have to do with six rows, and that at the same time two hydrothecæ belonging to two rows are not placed side by side, but sometimes higher, sometimes lower (that is to say, alternately). This will be better understood by examining the drawing which I have already given*. The form of the hydrothecæ is that of those of the *Sertulariæ* in general, furnished with a pretty long neck inclined outwards and slightly flattened, and with a wider part united with the stem. The aperture of the hydrotheca is operculate and furnished with two very distinct teeth placed at the corners of the orifice, which, in consequence of the compression of the neck, is elongated.

The gonophores in their young state have the form of a reversed cone attached by its apex (Pl. XV. fig. 5); but in the completely developed state they differ very little from the gonophores of *Sertularia* or *Thuiaria*. Their form is elon-

* Ann. & Mag. Nat. Hist. 1877, vol. xx. pl. vi. fig. 16.

gate oval, narrowed below into a short peduncle, and abruptly truncate at the extremity above, where they are narrowed into a sort of wide and very short tube. The arrangement of the gonophores upon the branches may be in four rows; and frequently they are in such great numbers and so close together that they compress one another and then acquire an irregular form. When looked at from above they then have the appearance shown in the accompanying figure (fig. 10).

Fig. 10.



This species, which I only describe very briefly now, was at first named by me *P. Hincksii*; but as I have since convinced myself that it was described several years ago under the name of *Diphasia mirabilis*, the laws of priority compel me to change the name, and to call it *Polyserias mirabilis*. At the same time I shall change the name of another *Polyserias*, which I have briefly described as *P. glacialis*, and I shall give it the name of *P. Hincksii*, in honour of the Rev. Thomas Hincks. The description of this species will follow immediately.

It must be remarked that *Polyserias mirabilis* is one of the most magnificent, and, at the same time, one of the largest species that have been met with in the White Sea. Nor can I say that it is rare, as I have several specimens of it from several localities. The largest specimens, which have only retained their branches in the upper part, measure nearly 16 centims. Their colour is a rather dark brown, darkest especially on the principal stem and at the ends of the lateral branches. The length of the branches is from 1 to 2 centims., and their width about 1·1 millim. Length of hydrothecæ 0·55 millim., their breadth 0·48; length of the mature gonothecæ 1·1 millim., their breadth 0·63.

This species, as indeed the whole genus, is purely polar, and apparently even circumpolar.

Localities.—1. The island of Solowetzky, near the monastery, at a small depth (not more than 15 fathoms); 2. Near the promontory of Orlow (White Sea), 67° 17′ N. lat. and 41° 35′ E. long., at a depth of 35 fathoms, on a gravelly bottom, June 28, 1876 (gonophores present); 3. Glacial Ocean, N.E. of the Swiatoy Nos (the Holy Nose), on the Mourmansky bereg, 68° 13′ N. lat. and 40° E. long., at a depth of 60 fathoms, on a bottom of sand and shells, June 30 (the best specimens, with many gonophores).

Polyserias Hincksii, nov. sp. (Pl. XV. figs. 1–4.)

Polyserias glacialis, Mereschk. Ann. & Mag. Nat. Hist. vol. xx. (1877) p. 228.

Colony rather rigid, plumiform, attaining a length of 20 centims. and a breadth of 10 centims. The principal stem is angularly bent, and only bears two kinds of hydrothecæ. From each angle issues a branch, which at first forms with the main stem an angle of about 45°; but afterwards this angle enlarges more and more until the position of the branch becomes vertical to the main stem. The branches are long, cylindrical, attain a length of 6·5 centims., and become shorter in proportion as they approach the apex of the colony. They are attached by means of a short and slender peduncle; their arrangement is alternate and in the same plane (Pl. XV. fig. 1). The hydrothecæ upon the branches are always arranged in six rows, as in the preceding species, and in the same alternate manner; but here each pair of rows (fig. 2) forms a distinct system, separated by a small interval not occupied by hydrothecæ. The roundness of the branches is more distinct in this species, as also the rows of hydrothecæ. The thickness of the branches is very considerable, and still greater in the youngest. The hydrothecæ are oval, a little wider below, with a more or less regular oval aperture; they are immersed in the stem for their whole extent, and their neck does not project outwards. In the lower part of the hydrothecæ there is a small tube, which constitutes the communication between the hydrotheca and the central canal which traverses the whole length of the branch. Colour of the branches pale yellow, that of the main stem dark brown; the points of the branches are not of darker colour as is usual in *P. mirabilis*.

Gonophores in the young state (fig. 4) in the form of a reversed cone, just as in *P. mirabilis*, but generally smaller. In the adult state (fig. 3) they retain their conical form, but the cone becomes larger and more elongated; below, it is attached by a short peduncle; above, it is truncate with the margins much rounded, and furnished with a tube of very inconsiderable length, which is scarcely observable, and much narrower than in the preceding species. The gonothecæ of this species are never present in such abundance as in *P. mirabilis*.

This species, the largest that I am acquainted with in the White Sea, is distinguished from the preceding by the greater breadth of the colony, due to the extreme length of the lateral branches, by the much lighter colour, and especially by the stout, cylindrical form of the branches, the surface of which is

completely smooth, in consequence of the form of the hydrothecæ, which more approaches that occurring in *Thuiaria*, being entirely immersed in the chitinous substance, while the outwardly curved necks of *P. mirabilis* give a hispid aspect to its branches.

Width of the branches of the middle of the colony 0·75 and 0·85 millim., of the uppermost branches 1·10 millim.; length of the hydrothecæ 0·52 millim. (at the end 0·57), their breadth 0·34 millim. (at the end 0·45); length of the gonothecæ 0·9 millim., their breadth 0·5.

This species, which is a still more magnificent one than the preceding, is not more rare; but it is especially from the Glacial Ocean (near the Swiatoy Nos) that I have collected the largest and most luxuriant specimens.

Localities.—1. White Sea, near the promontory of Intzy (on the Zimnij bereg), in 66° N. lat. and 40° 25′ E. long., at a depth of 10 fathoms, on a stony bottom, June 23 (without gonophores); 2. Glacial Ocean, N.E. of the Swiatoy Nos, upon the Mourmansky bereg, in 68° 13′ N. lat. and 40° E. long., at a depth of 60 fathoms (the large specimens), upon a bottom of sand and shells, June 30, 1876 (with gonophores).

Propositions.

The following are the fifteen propositions, contained in the present memoir, which, I think, I can sustain and defend:—

1. Forms like *Syncoryne*, *Coryne*, *Gemmaria*, *Stauridium*, *Cladonema*, *Millepora*, &c. form a type which I name the articulate type; all these forms are governed by the *law of metamerism*.

2. Articulation is produced by incomplete transverse division.

3. The very large number of metameres is produced by the law of physiological inertia of N. Wagner.

4. The articulate form in the Hydroids is almost always accompanied by capitate tentacles; this form is the best adapted to fulfil the function of defence, the only function that remains to them when their position has become too distant from the mouth.

5. The exceptions to this rule may be perfectly well explained, and by no means contradict proposition 3.

6. The hydranth with its tentacles may be regarded as a polymorphic colony (tentacles and body) composed of several *Archhydræ*, Häck., produced by the process of gemmation. The tentacles are not the homologues of such organs as feet, hands, &c.; they are only their analogues.

7. The medusa of *Obelia flabellata* is developed in the manner ascertained by F. E. Schultze in the case of *Syncoryne Sarsii*, in the first place by the impulsion of the active ectoderm into the passive endoderm.

8. The first stages of the development of the ova of the medusa of *Obelia flabellata* before fertilization consist in a repeated division of the *nucleolulus*, followed by the division of the *nucleolus* into several parts, a division which stops at the *nucleus*.

9. *Obelia flabellata*, under certain conditions, appears to be able to increase by spontaneous fission by a sort of cyst, after the fashion of *Schizocladium ramosum* and *Corymorpha*.

10. There are more than forty species of Hydroids in the White Sea, about eight of which are new. The fauna is more polar than that of the north of Norway and the Mourmansky bereg, and shows some oriental features (*i. e.* features of the fauna of the Pacific Ocean). It does not prove Lovén's hypothesis of a connexion between the White Sea and the Baltic.

11. *Oorhiza borealis*, nov. gen. et sp., is distinguished by the sporosacs issuing immediately from the hydrorhiza without the intervention of blastostyles.

12. There are Hydroids (*Oorhiza borealis*) the tentacles of which are furnished with eyes (or "eye-pigment").

13. The northern variety of *Sertularella polyzonias* must constitute a distinct species—*Sertularella gigantea*, mihi.

14. *Sertularia albimaris*, new species, with a hydrorhiza in a continuous layer. Description of *Leptoscyphus Grigoriewi*, nov. sp.

15. The forms of the family Sertulariidæ, which have their hydrothecæ arranged not in two but in several series, must form a new genus, *Polyserias*. (Description of two species.)

EXPLANATION OF PLATES.

Plate XIII.

Fig. 1. Young medusa of *Obelia flabellata* in the form of *Archhydra*.

Figs. 2, 3. Subsequent stages of development, in which the ectoderm alone is active and buries itself in the endoderm.

Fig. 4. Optical section of fig. 5.

Fig. 5. The four radial canals, strongly developed; commencement of the formation of the manubrium.

Fig. 6. Young medusa still attached to the blastostyle.

Fig. 7. Medusa of *Obelia flabellata*, completely developed and furnished with four sporosacs.

Figs. 8, 9, 10. Ova taken from the sporosacs of the medusa of *Obelia flabellata*, not fecundated, and showing different stages of development of the nucleolus and nucleolulus.

Fig. 11. The nucleus, highly magnified, to show the relative size of the

nucleolulus and its irregular, variable form: n', nucleus; n'', nucleolus; n''', nucleolulus.

Figs. 12, 13. More advanced stages of the development of the ovum, associated with an enlargement of the ovum.

Fig. 14. A second observed case of a nucleolus in process of division: n'', nucleolus.

Fig. 15. A nucleolus (n''), much magnified, with a nucleolulus (n''') in the middle and an aureole of five small granules.

Fig. 16. The apex of a stem of *Obelia flabellata*, in which the cœnosarc has become detached as a cylinder with a cavity.

Fig. 17. A hydrotheca in which the cœnosarc has formed, instead of a cylinder, a sphere with a cavity, ectoderm, endoderm, and perisarc.

PLATE XIV.

Fig. 1. *Leptoscyphus Grigoriewi*, nov. sp., magnified, drawn with the camera lucida.

Fig. 2. Two varieties presented by the hydrothecæ of *Leptoscyphus Grigoriewi*, more highly magnified. Drawn with the camera lucida.

Fig. 3. *Sertularia albimaris*, nov. sp., principal stem and lateral branches. Enlarged; drawn with the camera lucida.

Fig. 4. A colony of *Sertularia albimaris*, natural size.

Fig. 5. Portion of the hydrorhiza of the same, much enlarged (camera lucida): *a*, the spines; *b*, the vertical partitions formed by the lateral walls of the tubes, which are joined in growing.

Fig. 6. *Sertularella gigantea*, mihi, natural size.

Fig. 7. The same, enlarged.

PLATE XV.

Fig. 1. A very fine colony of *Polyserias Hincksii*, nov. gen. et sp.

Fig. 2. Part of a stem of the same Hydroid, enlarged (camera lucida).

Fig. 3. A mature gonotheca of *Polyserias Hincksii*.

Fig. 4. A young gonotheca of the same.

Fig. 5. *Polyserias mirabilis*, with immature gonothecæ (camera lucida).

Fig. 6. A mature gonotheca of the same Hydroid.

Fig. 7. Part of a colony of *Oorhiza borealis*, nov gen. et sp., enlarged, from a sketch by M. Wagner.

Fig. 8. Sporosacs of *Oorhiza borealis*, issuing from the hydrorhiza.

Fig. 9. Tip of a tentacle of *Oorhiza borealis* with pseudopodium-like filaments and red pigment grains (eye-pigment).

Fig. 10. A body on a peduncle, moving like an *Amœba*, and giving origin to filaments.

Fig. 11. Another tip of a tentacle, to show the arrangement of the filaments.

XXXVII.—*Descriptions of twenty new Species of* Hesperidæ *from his own Collection.* By W. C. HEWITSON.

Plesioneura Tola.

Alis utrinque nigro-fuscis: anticis fascia media, regulari, nervis albis quinquepartita, nivea.

Both sides dark brown. Anterior wing crossed in the

middle from the subcostal nervure to a little below the first branch of the median nervure, below which it is narrow, by a broad oval, regular, transparent snow-white band, divided by the nervures, which are of the same colour.

Exp. 2 inches.

Hab. Tondano (*Wallace*).

Plesioneura Crona.

Alis utrinque fuscis: anticis fascia media, regulari, nervis fulvis tripartita, aurantiaca.

Both sides dark brown. Anterior wing crossed in the middle from the subcostal nervure, where it is narrow, to the first branch of the median nervure, where it is broadest, by a semitransparent regular band of orange.

Exp. $1\frac{15}{20}$ inch.

Hab. Batchian (*Wallace*).

Plesioneura Cythna.

Alis utrinque rufo-fuscis: anticis fascia media hyalina alba, nervis albis tripartita: posticis basi margine costali albo nitido.

Upperside rufous-brown. Anterior wing crossed in the middle from the subcostal nervure, where it is narrow, to the first branch of the median nervure, where it is broadest, by a transparent band of white. Posterior wing with the costal margin from the base to its middle white and polished.

Underside as above, except that the white band is continued to the inner margin.

Exp. $1\frac{3}{20}$ inch.

Astictopterus Verones.

Alis utrinque rufo-fuscis: anticis infra macula apicali fulva.

Both sides rufous-brown.

Underside of the anterior wing marked by a subapical rufous spot.

Exp. $1\frac{6}{20}$ inch.

Hab. Sumatra (*Wallace*).

Astictopterus Harmachis.

Alis utrinque fuscis: anticis fascia lata, irregulari, angulata, nervis nigris quadripartita, hyalina, flava.

Both sides dark rufous-brown. Anterior wing crossed in the middle from the subcostal nervure to the submedian nervure by a very irregular angular transparent band of yellow, divided into four parts by the nervures, which are black: the

first part large and oblong within the cell, the second triangular between the second and third branches of the median nervure, the third oblong and bounded by the first and second branches of the median nervure; two small spots, one of which is very minute, towards the apex.

Underside as above.

Exp. 2 inches.

Hab. Sumatra (*Buxton*).

This species is also in the collection of Dr. Staudinger, from Malacca.

Astictopterus Ozias.

Alis utrinque fuscis: anticis supra fascia media sinuata, nervis flavis quadripartita, hyalina, flava: infra, anticis apice, posticis fasciis duabus latis cinereis.

Upperside dark rufous-brown. Anterior wing crossed at the middle, from the subcostal nervure to the submedian nervure, by a broad irregular transparent band of yellow, divided by the nervures, which are of the same colour, and twice indented on its inner border: the first part within the cell triangular; the second triangular, formed by the median nervure and its second and third branches; the third oblong between the first and second median branches.

Underside. Anterior wing as above, except that the apex is broadly grey. Posterior wing crossed below the middle by two broad bands of grey.

Exp. $1\frac{9}{10}$ inch.

Hab. Java.

This species is also in the collection of Dr. Staudinger, from Java; my specimen is without a locality.

This and *Harmachis* have the appearance of *Hesperia*.

Astictopterus Othonias.

Alis utrinque rufo-fuscis: anticis fascia media tripartita maculaque aurantiacis.

Both sides rufous-brown. Anterior wing crossed at the middle from the subcostal nervure to near the submedian nervure by an irregular band, broken into three orange spots by the nervures: the first in the cell; the second oblong, bounded by the first and second branches of the median nervure; a fourth spot, outside of these, placed between the second and third branches of the median nervure.

Exp. $2\frac{3}{20}$ inches.

Hab. Borneo.

Astictopterus Vibius.

Alis utrinque fuscis: anticis macula magna media, sub apice sinuata, aurantiaca.

Both sides dark rufous-brown. Anterior wing with a large central orange spot, circular, except opposite the apex, where the brown is obtruded in a quadrate form.

Exp. $1\frac{3}{20}$ inch.

Hab. Gaboon.

Ceratrichia flava.

Alis utrinque flavis: anticis margine postico late nigro punctis duobus minutis sub apice notato: posticis apice nigro. Infra: anticis maculis apicalibus albo notatis: posticis semicirculo punctorum nigrorum.

Upperside bright yellow. Anterior wing with the outer margin black, marked beyond the end of the cell by a minute yellow spot, and near the apex by a very minute spot of the same colour. Posterior wing with the apex black; some minute black spots on the outer margin.

Underside yellow. Anterior wing as above, except that the apex is rufous, marked by black spots, each marked by a minute white spot; the margin black, traversed by a line of yellow; the fringe black and white alternately. Posterior wing with two or three subbasal brown spots, followed by a semicircular series of brown spots, some of which are marked with yellow; a submarginal series of minute black spots; the margin also spotted with black.

Exp. $1\frac{3}{20}$ inch.

Hab. Cameroons (*Rutherford*).

Ceratrichia Aretina.

Alis rufo-fuscis: anticis maculis sex albis hyalinis maculaque opaca, posticis maculis tribus: posticis infra flavo minioque tinctis.

Upperside dark rufous-brown. Anterior wing with six transparent white spots: one near the inner margin, one intersected by the median nervure, the third beyond this, and three near the apex. Posterior wing with two transparent central spots: one before the middle; the other below it, bifid.

Underside. Anterior wing as above, except that the base of the costal nervure is white, and that there are some pale spots near the apex. Posterior wing with the costal half yellow-white, marked by two or three small brown spots, and on the costal margin by a carmine-brown spot; anal half, except the

abdominal fold, which is pale yellow, carmine-brown, marked by the transparent spots as above.

Exp. $1\frac{1}{10}$ inch.

Hab. Calabar.

The two species which I have described, together with *C. nothus* and *C. Cæsar*, form Mr. Butler's well-marked genus *Ceratrichia*.

Pterygospidea grisea.

Alis utrinque griseis, fasciis tribus macularibus nigris: anticis punctis octo albis hyalinis.

Upperside dark brown, so thickly irrorated throughout with white as to give it the appearance of being dark grey. Both wings crossed by three irregular bands of black spots. Anterior wing with eight small transparent spots: three from the middle of the costal margin (two of which are in the cell), two between the branches of the median nervure, and three near the apex.

Underside as above, but paler.

Exp. $1\frac{9}{20}$ inch.

Hab. Gaboon (*Rogers*).

Pterygospidea Kehelatha.

Alis utrinque rufo-brunneis: supra fasciis duabus transversalibus nigris: anticis macula nigra subbasali maculisque septem albis hyalinis, quatuor in medio positis.

Upperside bright rufous-brown. Both wings crossed beyond the middle by a band of brown and by a submarginal band of the same colour, partly broken into spots. Anterior wing with a distinct black spot not far from the base of the inner margin; seven transparent white spots, four of which are in the middle, one on the costal margin, one in the cell large and quadrate but sinuated on its inner border, and two below it between the branches of the median nervure. Posterior wing with two or three subbasal indistinct brown spots; the outer margin angular at the middle.

Underside rufous-brown. Anterior wing as above. Posterior wing marked by several black spots: three (one of which is bifid) in a semicircle before the middle, and seven in pairs, also forming a semicircle beyond the middle.

Exp. $1\frac{1}{2}$ inch.

Hab. Macassar (*Wallace*).

Pterygospidea Sephara.

Alis utrinque rufo-brunneis: anticis punctis tredecim hyalinis,

fascia media, fascia subapicali fasciaque anali fuscis: posticis basi apiceque fuscis, fasciisque duabus pallide brunneis.

Upperside rufous-brown, marked by thirteen transparent white spots, all of which, with one exception, are very minute: five near the middle of the costal margin, three of which are in the cell, where two of them are upon a spot of brown; four below these between the branches of the median nervure and the submedian, one of which is square and larger than all the rest, one very minute, and one linear; and four near the apex, all placed upon a transverse brown band; a band of brown near the apex and also near the anal angle. Posterior wing with the base and apex dark brown, a brown spot on the costal margin, and two transverse bands of paler brown.

Underside as above, except that it is without the brown at the middle of the anterior wing, as well as that at the base of the posterior wing.

Exp. $1\frac{3}{10}$ inch.

Hab. Brazil.

This and the last described are most nearly represented by *P. truncata.*

Hesperia Netopha.

Alis fuscis: anticis maculis quinque hyalinis maculaque opaca alba: posticis macula media bipartita alba. Infra anticis radiis apicalibus flavis: posticis flavis maculis margineque posteriore nigris.

Upperside dark brown. Anterior wing with six white spots, five of which are transparent: two in the cell; four in a longitudinal central band, the first near the inner margin, opaque, the last towards the apex, very minute. Posterior wing with a trifid pale yellow central spot.

Underside. Anterior wing as above, except that the outer margin is ochreous and that there are rays of yellow at the apex. Posterior wing yellow, marked by several black spots: two at the base, two before the middle, followed by a transverse curved band of six; the outer margin and some of the nervures where they touch it dark brown; the fringe yellow.

Exp. $1\frac{8}{20}$ inch.

Hab. West Africa.

Hesperia Nyassæ.

Alis fuscis: anticis maculis quatuor hyalinis maculaque opaca alba: posticis macula media bipartita flava. Infra anticis apice cineraceo, fusco striato: posticis cineraceis, maculis nigris notatis.

Upperside dark brown. Anterior wing with five white spots: one in the cell bifid, four in a central longitudinal band, the first near the inner margin opaque, the last towards

the apex scarcely visible. Posterior wing with a bifid ochreous central spot.

Underside. Anterior wing as above, except that the costal margin is rufous, the apex broadly lilac-grey, intersected between the nervures by lines of dark brown. Posterior wing lilac-grey, marked by several black spots: two at the base, three in a transverse band before the middle, and four beyond the middle.

Exp. $1\frac{1}{2}$ inch.

Hab. Nyassa (*Thelwall*).

This and the last described are very different from any other species, but singularly like each other in marking, though upon a totally different ground-colour.

Hesperia vermiculata.

Alis supra fuscis: anticis punctis quinque hyalinis punctoque opaco flavis, puncto in cellula punctisque in fascia longitudinali positis: posticis fascia margineque anali flavis. Infra anticis radiis apicalibus flavis: posticis flavis maculis nigris albisque.

Upperside dark brown. Anterior wing with six spots, five of which are transparent and slightly tinted with yellow: one in the cell, oblong; five in a longitudinal central band, the first of which near the inner margin is opaque, the last, towards the apex, minute. Posterior wing with an oblique short central band and the fringe yellow; the anal angle also broadly yellow. The abdomen dark brown, banded with yellow.

Underside. Anterior wing as above, except that there are two lines of yellow from the base of the costal margin, which are united near its middle; rays of the same colour at the apex, and a triangular white spot at the end of the cell. Posterior wing yellow, spotted with black and white; the base and costal margin dark brown, with the nervures yellow; two white spots below the middle of the costal margin, a white spot near the inner margin; a transverse series of black spots below the middle, followed by a series of white spots, and again by an apical series of black spots. The white spots slightly tinted with blue.

Exp. $1\frac{7}{10}$ inch.

Hab. Sumatra (*Buxton*).

A beautiful species, near *H. Liburnia* and *H. Latoia*.

Syrichthus Cenchreus.

Alis fuscis, fascia submarginali macularum albarum: posticis fascia media maculari alba: posticis infra albis, fasciis tribus fuscis.

Upperside dark brown. Both wings with a submarginal

series of white spots; the fringe brown, bordered inwardly with white. Posterior wing with a spot in the cell, and a central band of oblong white spots.

Underside. Anterior wing as above, except that it is white near the base. Posterior wing white, crossed by three bands of dark brown: one before the middle, short; one below the middle, longer; and one submarginal, broadest and longest and irrorated with white.

Exp. $1\frac{1}{10}$ inch.

Hab. Para (*Bates*).

Arteurotia Cambyses.

Alis supra nigro-fuscis, fascia submarginali maculari cineracea. Infra fuscis: anticis margine interiore cinereo: posticis fasciis duabus indistinctis.

Upperside black. Both wings with a submarginal series of grey spots, largest at the apex of the anterior wing, scarcely visible towards its anal angle. Anterior wing with a very indistinct short band of grey from the middle of the costal margin. Posterior wing with a similar band in its middle.

Underside. Anterior wing dark brown, the apex paler, the inner margin grey. Posterior wing red-brown, with the costal margin and two indistinct transverse bands of darker brown.

Exp. $1\frac{6}{10}$ inch.

Hab. Bolivia (*Buckley*).

This species is nearly allied to *Mycteris cærula* of Mabille, which belongs to this genus.

Arteurotia Castolus.

Alis utrinque fuscis: anticis punctis tribus subapicalibus hyalinis. Infra anticis puncto cinereo apicali: posticis angulo anali late cineraceo, fusco undulato.

Upperside dark brown. Both wings indistinctly variegated by grey. Anterior wing with three minute subapical transparent spots.

Underside as above, except that there is a small grey spot at the apex of the anterior wing, and that the anal half of the posterior wing is grey undulated with brown.

Exp. $1\frac{3}{10}$ inch.

Hab. Brazil.

Arteurotia Celendris.

Alis utrinque fuscis: anticis punctis duodecim minutis hyalinis: posticis dimidio inferiore cinereo, fascia submarginali fusca: his infra fascia media maculari alba maculaque anali magna nigra.

Upperside dark brown. Anterior wing with twelve minute transparent spots: three at the middle of the costal margin, two of which are in the cell; six in a central oblique band, two of which are lunular; and three near the apex; a minute white spot on the fringe at the apex, and a lunular spot of the same colour near the anal angle. Posterior wing with the outer half grey, bordered above with white, crossed near the outer margin by a band of dark brown.

Underside. Anterior wing as above, except that there are two minute white spots above the lunular spot near the anal angle. Posterior wing with a band of white spots at the middle, a series of smaller white spots below these, and a large black spot at the anal angle bordered above and below with white.

Exp. $1\frac{7}{20}$ inch.

Hab. Amazons (*Bates*).

Conognathus Platon of Felder is the typical representative of this genus; but as Mr. Kirby informs me that *Conognathus* is preoccupied, I have adopted *Arteurotia* of Butler and Druce. *Thracides Aristoteles* of Westwood also belongs to this genus, and bears very little resemblance to the species which Hübner puts into his genus *Thracides*.

XXXVIII.—*Note on* Artamus monachus. By Dr. F. Brüggemann.

In 1850 Prince Bonaparte established a new species of *Artamus* from Celebes (*A. monachus*), with the following diagnosis:—"Capite, alis caudaque nigris" (Consp. Avium, i. p. 343).

In 1877 Dr. Sclater established a new species of *Artamus* from New Ireland (*A. insignis*), with the following diagnosis:—"Diversus ab *A. monacho* capite alis et cauda nigris" (Proc. Zool. Soc. 1877, p. 101).

Going further into the question, it may be mentioned in advance that *A. monachus* was first distinguished and named by Temminck; but as the Dutch ornithologist never gave a description of it, we have not at all to deal with an *A. monachus* of Temminck, as quoted by most authors. The next account of the species was given by the illustrious traveller Wallace, who described specimens from North Celebes and the Sula Islands (P. Z. S. 1862, p. 340), as having the head, wings, and tail ashy grey instead of black. Upon this, Lord Walden, in his elaborate memoir on the birds of Celebes (Trans. Zool. Soc. viii. p. 67), where also a good figure of the

species is given, expressed his doubts about the identity of Bonaparte's and Wallace's birds. Having found again the characters indicated by Wallace in one of Von Rosenberg's specimens, I suggested in a previous paper (Abh. Ver. Brem. v. p. 69) that there might be a *lapsus calami* in Bonaparte's statement.

Such being the state of affairs, until a short time ago, there could not be much objection to naming the Celebean bird "*A. monachus*." Bonaparte's diagnosis is, indeed, short enough; and recently one of his appellations, although in general use, has been rejected on account of its being accompanied by a diagnostic phrase consisting of only *four* words. However, I cannot agree in fixing a certain number of words as indispensable for the establishment of a species. This would lead to a most trivial higgling; for it is extremely difficult to tell how many words should be considered sufficient. In some cases, I think, even a single word might do; besides it can never be demanded that the first description of a species should be exhaustive in every respect. But Bonaparte's diagnosis is erroneous; and, as lately the *Oriolus indicus* has been renamed because of a wrong original description, it might have been regarded as necessary to find a new name for our bird. But this objection is, in my belief, not sustainable, as the species could be ascribed to Wallace, as well as the *Oriolus indicus* to Jerdon.

However, it has become unavoidable to rename the Celebes bird; for now a species is known answering fully to Bonaparte's diagnosis, viz. *A. insignis*; and therefore I venture to propose the name of *A. spectabilis* for the former. It now little matters whether Bonaparte's term "*nigris*" is miswritten or not, and whether the type in the Leyden Museum is really *A. insignis* (and in this case the *habitat* would be wrong) or *A. spectabilis* (and then the description would be wrong); on the contrary, I consider it best, under such circumstances, to drop "*A. monachus*" altogether, and to use the new names for the two species respectively.

XXXIX.—*Description of an apparently new Species of Pigeon of the Genus* Ptilopus. By D. G. Elliot, F.R.S.E. &c.

Ptilopus pictiventris.

Adult. Front and crown rosy purple, with a faintly indicated yellow margin. Occiput greenish grey. Throat whitish; neck, upper part of mantle, and breast ashy green.

Flanks light green. Centre of abdomen rufous, bounded above by a deep purple line. Crissum and under tail-coverts bright yellow, the latter orange towards their tips. Back and upper tail-coverts bright green. Scapulars tipped with lilac. Tail bright green, with a broad apical yellow band. Bill greenish, with a yellow tip. Feet probably dark red. Total length $8\frac{1}{2}$ inches, wing $5\frac{1}{4}$, tail 3, culmen $\frac{9}{16}$ inch.

Hab. Nukahiva (type), Marquesas Islands, Samoa (*Whitmee*); Savage Island, Navigators' and Friendly Islands *Layard*).

This is, I presume, the bird called *P. apicalis* by Layard in the 'Proceedings of the Zoological Society' for 1876, p. 495. It differs from the *P. apicalis*, Bon., a very distinct species, by being of a much lighter colour on the neck and breast, and by having the rufous of the abdomen bounded above by *deep purple*, and the scapulars tipped with lilac. In the type of *P. apicalis* there is no purple on the abdomen, the patch being rufous mixed with yellow, and the scapulars are uniform green. The locality Vavao, given by Bonaparte, is questionable, as the type was brought by Hombron and Jacquinot from the Samoan Islands; but which one is not stated. The type of the *Ptilopus pictiventris* is now in the collection of the Paris Museum, and came from *Nukahiva*, of the Marquesas group. I have also seen two specimens in the British Museum, sent by the Rev. S. J. Whitmee from Samoa and Savage Island, which are precisely like the type, and bore upon their label (written by Mr. Whitmee) the name of *Ptilopus fasciatus*, Peale, which is a very different species, in no way to be confounded with it. As there is considerable confusion still existing among these small fruit-pigeons of the South-Sea Islands, I will add that the present new species differs from the others with a yellow apical band on the tail especially by the colouring of the abdomen. Its proper position in the group will be fully shown in a paper upon these birds, on which I have been for some time engaged, and have now nearly ready for publication.

MISCELLANEOUS.

On Dinichthys, *Newberry.*

Prof. Owen, followed in this by Prof. Huxley, constituted an order, Protopteri (Dipnoi, Huxley), for the genus *Lepidosiren*, which combines with essentially ichthyic characters structural peculiarities which greatly approximate it to the perennibranchiate Batrachians. Paul Gervais and others, on the contrary, class the

type of this order among the Ganoids; and Dr. Günther, going still further, regards the Dipnoi as nothing more than a suborder of the Ganoids, and thinks that these latter should be united with the Plagiostomi, to form with them a single order (Palæichthyes) characterized by a heart furnished with a contractile arterial bulb, an intestine with a spiral valve, and uncrossed optic nerves.

The discovery of *Ceratodus Forsteri* certainly seems to diminish the value of the order Dipnoi. This fish, which approaches *Lepidosiren* in regard to its respiratory apparatus, departs from it, on the other hand, by the structure of its heart, which is perfectly ganoidean, consisting only of two cavities with an arterial bulb; moreover the intestine is furnished with a spiral valve. The genus *Dinichthys* is a new type, which, combining the osteological characters of the Lepidosirens and those of the Placoderms (cuirassed Ganoids), furnishes an additional argument in favour of M. Gervais's opinion and establishes a fresh transition between the different groups of Ganoids.

Besides its great size (a cranium measures 3 feet in length and 2 in breadth) the *Dinichthys* is especially remarkable by its dentition. The lower jaw consists of massive rami, the posterior extremities of which are rounded and flat. The anterior part of each ramus is bent upwards so as to form a sort of strong, acute, and prominent tooth; behind this tooth the jaw is thickened by a bony projection on the inside, which terminates in front in a triangular process like a tooth; beyond this process the margin of the mandible is compressed for a distance of 5 or 6 inches, and consists of a very dense bone-like enamel; in one species this margin is entire but trenchant; in another it is denticulated with conical points half an inch long.

The upper jaw consists of two triangular premaxillaries, constituting, as it were, two great incisors, followed by two maxillaries with trenchant or denticulate margins. This structure much reminds us of the dentition of *Lepidosiren* and *Coccosteus*; and the resemblance becomes still more striking when we compare figures representing these three forms. Unfortunately, the upper part of the cranium being but imperfectly known, we cannot tell whether the bones called premaxillaries by Mr. Newberry are or are not the homologues of the dentigerous nasals of *Lepidosiren*; but with respect to the mandible the resemblance is as complete as could be desired.

The body of *Dinichthys* was covered with a buckler composed of plates exactly similar to those of *Coccosteus decipiens*, of the same number, and arranged in an almost identical manner, the only differences shown by a comparison of the figures being a certain narrowness of the buckler and the termination in a sort of point of the outer angle of the posterior plates.

The jaws of *Dinichthys* present several points of resemblance to those of *Coccosteus*; but this is not the case with the cranium and the back, the bony armour of which, in the former fish, much more resembles that of *Asterolepis* and *Heterosteus*. Whilst the outer

surface of the bony plates of the Placoderms is covered with stellate tubercles, that of *Dinichthys* is only marked with fine granulations, with slightly deeper and very irregular furrows. The fins are only known from a fragment 6 inches long and 3 or 4 inches broad, which probably formed part of a median fin with ossified rays as thick as a man's little finger.

Thus, as we pass from the *Dipteri* of the Devonian to the existing *Ceratodus Forsteri* by means of the Carboniferous *Ctenodus* and the Triassic *Ceratodus*, so *Dinichthys* binds together *Coccosteus*, *Pterichthys*, *Asterolepis*, and *Lepidosiren*, although in both cases we by no means possess all the intermediate forms.—*Bibl. Univ.* June 15, 1877, *Arch. des Sci.* p. 195.

On an Ostracode Crustacean of a new Genus (Acanthopus), *met with in the deep Waters of the Lake of Geneva.* By M. H. Vernet.

This entomostracan cannot be referred to any type hitherto observed in fresh water; it belongs to the marine family Cytheridæ. Like the representatives of that family it possesses only a single pair of maxillæ, and, on the other hand, three pairs of feet armed with strong hooks at their basal articulation (the other freshwater Ostracodes having two pairs of maxillæ and two pairs of legs). The rudimentary postabdomen is reduced to two rounded lobes, each bearing two hairs. The antennæ also much more resemble the type of the Cytheridæ than that of the Cypridæ.

The reproductive apparatus does not present any thing peculiar; it resembles that of the Ostracodes in general. Besides the sexual tube there is a *receptaculum seminis* in the female, and a very complicated chitinous copulatory apparatus in the male. The vulvæ are placed below the two postabdominal lobes.

With regard to its mode of life, this crustacean is unable to leave the bottom. It does not swim at all; it sometimes creeps, but usually buries itself, and thus travels in the mud and organic débris by the aid of its feet and antennæ. The hairs and segments of the feet are driven into the mud, which serves as a support. The strong hooks of the basal articulation are especially useful, but give a somewhat awkward appearance to the mode of progression. The mechanism of this locomotion may be compared to that of a man who endeavours to advance upon his knees, aiding himself with his toes.

The two pairs of antennæ act in opposite directions; their action may be compared to that of the two anterior paws of a mole. These are the members which enable our crustacean to bury itself in the mud.

With reference to the origin of this organism two suppositions may be formed: it may be descended from a marine species introduced by some means into our lakes; or it may have for its ancestor a freshwater crustacean; the genus *Candona* would be that which it most resembles, though nevertheless very dissimilar. The field of hypotheses remains open upon this point.—*Bibl. Univ.* Oct. 15, 1877, *Arch. des Sci.* p. 334.

THE ANNALS

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[FIFTH SERIES.]

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XL.—*Notes on the Genus* Retepora, *with Descriptions of new Species.* By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Plates XVIII. & XIX.]

THE singular beauty of the Lace-corals has always attracted the collector; but, so far, little has been accomplished towards the elucidation of their history. Of the many forms which exist, especially in the Southern Ocean, few have been discriminated. Even the representatives of the tribe in Northern and British waters and in the Mediterranean have been only imperfectly investigated; and much remains to be done amongst them.

The notices of *Retepora* which we have from the older writers are valueless for purposes of identification; and the same remark applies to many of the descriptions of more modern date.

The following recent species have been described:—

From Australia:

Retepora phœnicea, *Busk.*
R. monilifera, *Macgillivray.*
R. porcellana, *id.*
R. granulata, *id.*
R. fissa, *id.*

I believe that the foregoing are all distinct from the forms described as new in this paper; but in so difficult a genus it is essential that the diagnosis should be much fuller and more minute than authors have usually made it, and identification is not always sure.

From the South Seas:

R. versipalma, *De Blainville* (Man. d'Act. p. 419).

Of this species the diagnosis is hopelessly defective.

From India:

R. indica, *D'Orbigny*.

Nothing is to be learnt of this species from the brief notice of it in the 'Paléontologie Française' (vol. v. p. 364); but it is identified by D'Orbigny with a form figured by Rumphius (Amboin. pl. 87. fig. 5); and as Busk quotes the latter as a synonym of his *R. phœnicea*, it is possible that this species and *R. indica* may be identical.

From Florida:

R. marsupiata, *Smitt* * (also from Teneriffe).

R. reticulata, *Pourtales* †. Ranked by Smitt as a variety of *R. Beaniana*, but probably a distinct species. Dredged from a depth of 270 fathoms.

R. reticulata of *Johnston & Couch* cannot be identified from their descriptions.

From the Arctic seas:

R. Wallichiana, *Busk & Hincks* ‡ (associated with *R. Beaniana*, King, and *R. cellulosa*, Smitt).

From the North Sea:

R. Edwardsii, *Van Beneden* § (probably identical with *R. cellulosa*, Smitt).

From the British seas:

R. Beaniana, *King* ‖.

From the Mediterranean:

R. cellulosa, *auctt.*

There has been much confusion amongst authors as to the application of this name. The northern form, with which Smitt has connected it, ranges to the Mediterranean; but it has probably been applied to other Mediterranean forms by the earlier writers.

I do not give this as an exhaustive list, though I believe that it will be found to include most of the described species

* Floridan Bryozoa, pt. ii. p. 67, pl. xiii. figs. 245–254.

† Ibid. p. 69, pl. xiii. figs. 242–244.

‡ Hincks on Polyzoa from Greenland (wrongly "Iceland" in the text) and Labrador, Ann. & Mag. Nat. Hist. for January 1877, p. 107, pl. xi. figs. 9–13.

§ "Sur les Polypes Bryozoaires de la Mer du Nord," Bull. Acad. Roy. d. Belg. vol. xv. no. 2 (1849), pl. x. figs. 9–13.

‖ Ann. & Mag. Nat. Hist. 1846, xviii. p. 237.

(if not all) which are recognizable. If so, the number of known forms is remarkably small compared with the probable extent of the genus.

The Retepores have a wide distribution in space, ranging from the Arctic seas to New Zealand and Australia, where they are represented by many species, and occurring in the Indian seas (Straits of Malacca &c.), at the Canary Isles, off Cape Horn, and on the southern coasts of North America. They have also a wide bathymetrical range, and have been taken at great depths as well as in comparatively shallow water.

The new species which I am about to describe are in part Australian; one of them is common to our own shores and to the Mediterranean; and one or two besides are inhabitants of the latter or of the Red Sea.

The most important specific characters in this group are the structure of the oral aperture, the shape and size of the *fenestræ*, and the form and position of the avicularian appendages. Some of the species are distinguished by a slit or fissure in the lower margin of the mouth, terminating below in a loop-like foramen; in others this is wanting. The genus may be conveniently divided into two groups, characterized by the presence or absence of the oral fissure.

Class POLYZOA, J. V. Thompson.

Subclass HOLOBRANCHIA, E. Ray Lankester.

Group *a*. *ECTOPROCTA*, Nitsche.

Order **GYMNOLÆMATA**, Allman.

Suborder **Cheilostomata**, Busk.

Genus RETEPORA, Lamarck.

a. *With an oral fissure.*

1. *Retepora Couchii*, n. sp. (Pl. XVIII. figs. 1–6.)

Retepora Beaniana, Hincks, Devon and Cornw. Cat., Ann. & Mag. Nat. Hist. ser. 3, ix. 306 (50, sep.).

Retepora cellulosa, var. *Beaniana*, Manzoni, Bryoz. Foss. Ital. quarta contrib. 19, pl. v. fig. 26 (Sitzungsb. d. k. Ak. d. Wiss. Bd. lxi. 1 Abth. März-Heft, 1870).

Zoarium irregularly cup-shaped, undulated and contorted, with a sinuated margin, hispid. *Fenestræ* small, oval; stem short. *Zoœcia* subcylindrical, depressed, except at the upper extremity, surface smooth; orifice semielliptical, the front

margin produced into a tall mucronate process, broad below and narrowing towards the apex, bent outwards, and bearing on its summit a minute avicularium, with rounded mandible; peristome elevated on one side of the mucro into a broad, wing-like process, produced at its upper and outer angle into a pointed spine; a slit-like fissure between the mucro and the lateral process, closed above, but forming a looped foramen below; elongate, linguiform avicularia, with a very delicate mandible, distributed over the zoarium, frequently one on the front of the cell towards the side. *Dorsal surface* vibicate, with many small subcircular and linguiform avicularia, irregularly placed. *Ooœcia* elliptical, smooth, with a narrow longitudinal fissure.

Height (of the largest specimen examined) a little more than ½ inch, breadth about ¾ inch.

Hab. On stones &c., deep water.

Localities. Off the Land's End (*R. Q. Couch*); south-west of Polperro, on stone, 40 fathoms (*T. H.*); Guernsey (*Rev. A. M. Norman*).

Distribution. Mediterranean, 390 fathoms ('Porcupine' expedition, *teste Busk*).

Range in time. Italian Pliocene beds (*Manzoni*).

The very much produced and recurved rostrum, with its minute terminal avicularium and the wing-like elevation of the peristome on one side of it, are the most salient and striking features of this species. But it is also distinguished from its allies *R. Beaniana* and *R. cellulosa* by differences in the *avicularia* and *fenestræ*. From the former it is also separated by the presence of an oral fissure.

This is probably the form which Borlase records from Scilly, and which Couch includes in his 'Cornish Fauna' under the name of *R. reticulata*, though it is quite impossible to identify it by their descriptions. I infer that it is the same species, because no other south-western Retepore has been brought to light by recent dredgings.

2. *Retepora prætenuis*, n. sp. (Pl. XIX. figs. 6–8.)

Zoarium forming a simple, reticulated frond, more or less curved and contorted. *Fenestræ* usually of large size, elongate, and narrowed towards both extremities; the branches very slender, commonly composed of only two rows of cells. *Zooœcia* ovate, very slightly convex, smooth; orifice suborbicular, peristome not elevated, a small fissure on the lower margin, and beside it usually a minute avicularium with rounded mandible; on the front of the cell, a little below the mouth, frequently a raised elongate avicularium; mandible

broad at the base, slender and somewhat curved above, directed downwards. *Oœcia* small, suberect, semielliptical, closely adnate to the cell above, somewhat flattened in front, produced below into a truncate process, which reaches down some way within the aperture; a short and narrow fissure in the front wall. *Dorsal surface* very slightly vibicate, with many scattered elongate avicularia.

Height (of fine specimens) about ¾ inch.

Locality. For my specimens of this very beautiful species I am indebted to R. S. Newall, Esq., F.R.S. It was included amongst a number of Polyzoa which were said to have been taken from a telegraph cable in the Red Sea. On examining the collection, however, I find it to contain so many Mediterranean forms that I suspect there has been some mistake about the locality. Probably both Mediterranean and Red-Sea forms may be mixed in it. Mr. Newall is unable to clear up the point; and I can therefore only refer the present species doubtfully to the Red Sea.

A large proportion of the specimens in the collection afford unmistakable evidence as to their habitat, the base from which they rise having been moulded on the cable and forming a cast of it.

R. prætenuis is one of the most beautiful of its tribe. Whether it ever assumes the caliculate form I am unable to say; but all the specimens which have come into my hands (about a dozen in number) consist of a simple reticulated expansion. The *fenestræ* are usually much elongated, and the inosculating branches which compose the network remarkably slender, giving an air of great lightness and delicacy to the whole structure, which is very slightly put together and extremely fragile. The oral fissure is very small, almost rudimentary, and is associated with a minute, rounded avicularium, rising from the lower margin beside it. The peristome is very slightly developed; and the structure of the oral aperture is essentially simple. The elongate and pointed avicularia are not present on every cell; but on every specimen a considerable number may always be met with, and they form a good distinctive character. They are raised on a mound-like elevation; and the slender acuminate mandible points, as a rule, straight downwards. The ovicell presents some very marked peculiarities. It is small and decidedly suberect; the front wall is flattened, and is prolonged below into a kind of lamina, subtruncate at its lower extremity, which extends some way into the aperture. The fissure is very short and narrow, and is not open below.

b. *Without an oral fissure.*

3. *Retepora plana*, n. sp. (Pl. XVIII. figs. 7, 8.)

Zoarium thin, flat, and compressed. *Fenestræ* rather large, usually pointed above and below, separated by wide interspaces (three or four rows of cells); habit of growth unknown. *Zoœcia* ovate, very slightly convex, surrounded by a raised line, surface smooth; orifice arched above, with a straight lower margin; peristome not raised, thin, entire, unarmed; frequently a small avicularium, with rounded mandible, immediately below the mouth, usually supported on an umbo. *Dorsal surface* smooth, vibicate, destitute of avicularia. *Oœcia* —— ?

Locality. Red Sea (probably). The specimens form part of the collection to which I have previously referred.

This very distinct species is characterized by the flatness and evenness of its surface, by its great simplicity of structure, and the slight development of the accessory appendages, which are usually so abundant amongst the Retepores. The cell resembles that of an ordinary *Lepralia* (auct.). The orifice is well arched above and straight below, the height somewhat exceeding the breadth, and is surrounded by a perfectly simple peristome, which is not raised above the level of the surface.

The small rounded avicularium, which is often present below the mouth, usually mounted on an umbonate rising, is the only appendage which occurs in my specimens.

4. *Retepora tessellata*, n. sp. (Pl. XIX. figs. 9–12.)

Fenestræ elongate, narrow, not so wide as the interspaces, which are broad and rather massive; habit of growth unknown. *Zooœcia* short-ovate, smooth, flattish, bordered by a raised line; orifice arched above, lower margin straight, with a small central sinus, the front wall (in the adult state) carried up on each side of it and terminating above in a somewhat pointed extremity, hollowed out below it; a spine immediately above each lateral prolongation of the front wall; usually on the front of the cell a slender elongated avicularium with pointed mandible, frequently placed transversely, but sometimes directed downwards; many stout processes distributed over the zoarium, standing out at right angles to its surface, and bearing a large pointed avicularium on one side. *Ooœcia* immersed, subglobose, smooth, hollowed out in front. *Dorsal surface* divided into numerous distinct areas, bounded by raised lines, each bearing one or more of the elongate avicularia.

Locality. South Australia*.

In this species the characters of the mouth are very distinctive. The shape and the minute marginal slit and the way in which the cell-wall in the adult is carried up on each side of it and hollowed out in front are all very characteristic points. The *avicularium* on the front of the cell is a very constant feature; it is sometimes depressed and sometimes slightly elevated above the surface.

Perhaps, however, the most marked peculiarity is to be found in the tessellated condition of the dorsal surface. It is mapped out into distinct areas, each bounded by a raised line, and is covered with great numbers of the pointed avicularia, similar to those which are so abundant on the front of the zoarium.

5. *Retepora robusta*, n. sp. (Pl. XVIII. fig. 9, 10.)

Zoarium thick and massive. *Fenestræ* elongate-oval, large, separated by very wide and solid interspaces; habit of growth unknown. *Zoœcia* regularly rhomboidal, surrounded by raised lines, which terminate above on a level with the inferior margin of the orifice; surface smooth, uneven, often depressed in the centre. *Orifice* arched above; lower margin almost straight; no sinus; occasionally a small oval avicularium placed transversely immediately under the lower lip, or upon it; on the front of most of the cells a somewhat tongue-shaped avicularium, pointing straight downwards, or sometimes placed obliquely, often occupying its central depression. *Oœcia* ——? *Dorsal surface* vibicate, with scattered small avicularia.

Locality. South Australia.

This species is distinguished from all the preceding by its massive zoarium and large reticulations. The meshes are much elongated and the inosculating branches of remarkable width and solidity.

There are points of agreement between it and Macgillivray's *R. porcellana*. But as he has not given us a detailed account of its minute structure, or a figure, it is impossible to decide whether such agreement implies specific identity. His description of the avicularium which occurs towards the middle of the cell in *R. porcellana*, as having a "short mandible," is sufficiently vague; but, so far as it goes, it does not apply to that of the present form, which is elongate and tongue-shaped.

* I am indebted for most of my Australian specimens to my friend H. R. W. Lemann, Esq., of Bath.

The very regular rhomboidal shape of the cell in *R. robusta*, and the way in which its bounding lines extend only to the inferior margin of the orifice and do not embrace the mouth itself, are distinctive points. Its most striking characteristic, however, is the stoutness of its habit, by which it can be at once distinguished from all the other southern species with which I am acquainted.

The species which follow have already been described; but I venture to supply a fuller account of them than we have from the authors who have previously noticed them. In studying this very difficult family I have vividly realized the necessity of thorough and minute diagnosis, if we are to escape the very serious evils of doubtful identification and a burthensome synonymy.

1. *Retepora monilifera*, Macgillivray*. (Pl. XIX. figs. 1–5.)

Zoarium regularly cup-shaped, or much convoluted, and forming a number of irregularly shaped cavities, the sinuous and anastomosing walls of which give a very intricate appearance to the surface; surface minutely granulated. *Fenestræ* very small, narrow-oval; interspaces broad. *Zoœcia* subcylindrical, distinct, flattish; orifice (primary) arched above, slightly curved outwards below, broader below than above, with a minute sinus on the inferior margin; secondary orifice (formed by the elevation of the cell-wall) orbicular, with a deep looped sinus in front, on each side of which is an ascending process, one of the two bearing on its inner side a small avicularium, the mandible directed upwards; a tall and stout jointed spine on one side just above the avicularium. Small oval avicularia distributed over the zoarium. Tall and stout aviculiferous processes, expanding downwards, often present in great numbers; the avicularium placed on the front with a pointed mandible. *Ooœcia* large, prominent, subpyramidal, with a granulated rim above the upper edge of the aperture, from the centre of which a somewhat clavate band, also granulated or beaded, extends upwards, almost to the top of the ovicell. *Dorsal surface* dense, minutely granular, slightly vibicate, with scattered small oval avicularia.

Locality. South Australia.

On the young marginal cells the primary orifice with its minute sinus is met with; in the older portions of the colony

* "Notes on the Cheilostomatous Polyzoa of Victoria and other parts of Australia," by P. H. Macgillivray, A.M., M.R.C.S. (Trans. Phil. Inst. of Victoria, vol. iv. 1860, p. 168, pl. iii. figs. 6–9).

it is almost entirely concealed by the secondary orifice. In this we find the characteristic orbicular shape, the large loop-like sinus, and the marginal processes and avicularium. The remarkable spine (Pl. XIX. fig. 3) which rises on one side of the orifice seems to have escaped observation. Its structure is peculiar. At the base it is articulated by a corneous joint to a small tubular process on the margin, and is composed of a number of segments or pieces, each of which is contracted below and expands upward, and seems to fit into the one beneath it; so that the spine presents an uneven outline and has the appearance of being jointed at pretty regular intervals. The large aviculiferous processes are often present in profusion and give a very marked character to the zoarium; occasionally, however, they are scantily developed. The variety of the avicularian appendages in this species is remarkable. In addition to those which have been described, there is occasionally a gigantic avicularium, exceeding the zooœcium in length, which occupies an elevated space at the top of the fenestræ, with a much elongated subspatulate mandible directed obliquely downwards. This is sometimes replaced by a very curious form, which I have not met with elsewhere. It is narrow-elliptical in shape, usually large, with a very solid semielliptical mandible, of a dark horn-colour (Pl. XIX. fig. 5). This form, I believe, is really an aborted condition of the gigantic avicularium just described, and consists essentially of the basal portion of the latter *minus* the long mandible. I was at one time induced to think that the form with the gigantic avicularia should be accounted distinct; but in its minute characters it agrees with the present species. It is perhaps worthy of being distinguished as *R. monilifera*, var. *munita*.

It should be noted that the aspect of the cell, and especially of its oral aperture, is subject to great variations, corresponding with the stages of growth and development. After the formation of the secondary orifice has been commenced, its sinus appears as a very small slit almost closed above, and the avicularium lies transversely on the margin beside it, without being elevated, as it is subsequently, on a mucronate process.

The peculiar structure of the ovicell, which has suggested the specific name, seems to be due to the filling-in of the fissure, which exists in the usual condition on the younger cells, with a granulated calcareous plate. The ooœcia are commonly developed in such quantities as almost to conceal the surface of the zoarium; and this profusion may perhaps be accounted a specific character.

R. monilifera affords a very striking illustration of the diversities in the habit of growth which are so characteristic of the present family. So utterly different in aspect are its simply caliculate and its convoluted and chambered variety, that it is difficult to believe that they are referable to one and the same species. I was at first so completely deceived by the very distinctive habit of the latter, combined with some other trifling peculiarities, that I had marked it as a new species, under the name of *R. contortuplicata*.

2. *Retepora phœnicea*, Busk *.

Zoarium of a rich red colour, irregularly cup-shaped, variously contorted, the edges of the lamina sometimes uniting so as to form cylindrical cavities. *Fenestræ* small, oval, the inosculating branches broad and rather massive. *Zoœcia* rhomboidal or irregularly ovate, commonly enlarged above, narrowed downwards, and truncate at the bottom, flat, with a conspicuous line and a few very large punctures round the edge; surface smooth and polished; orifice orbicular; peristome raised and somewhat thickened, subtubular, slightly bent forwards, the margin often serrulate; sometimes a minute circular orifice in the centre, immediately below it; a depression on the front of the cell below the mouth, from which a pointed avicularium extends upwards to the lower margin. *Dorsal surface* solid, smooth or minutely warty, strongly vibicate, and generally destitute of avicularia. *Ooœcia* globose, subimmersed; surface entire, smooth and shining, hollowed out in front, the fissure being filled in by a thick opercular plate, which is prolonged below within the orifice.

Locality. South Australia, Adelaide and Glenelg.

Mr. Busk has characterized *R. phœnicea* with his accustomed accuracy; but as his description is very concise, in harmony with the plan of his work, it may not be superfluous to furnish a further account of it.

To the elements of beauty which are common to the tribe, the charm of rich colouring is superadded in the present species; and its fine red tint is well preserved in fresh unbleached specimens. The cell exhibits strongly marked characters, but is subject to a certain amount of variation. The subtubular peristome is sometimes wanting, and the orbicular orifice, with its slightly thickened rim, is on a level with the surface. The edge is often entire and shows no trace of serrulation. The minute central foramen below the mouth I have

* Cat. Marine Pol. part ii. p. 94, pl. cxxi. figs. 1, 2.

not always been able to detect, even when it is not concealed by the apex of the suboral avicularium. The latter is not always present; but it must be accounted a characteristic feature of the species. It is immersed, extending from a depression situated about halfway down the cell, or less, to the lower margin of the mouth, on which its pointed extremity rests. It is rounded below and is furnished with a short mandible, very broad at the base, and tapering to a fine point. Very characteristic also is the flat, smooth, polished and tinted surface of the cell, bordered by a distinct raised white line, and sparsely punctured round the edge. The punctures or *foramina* are of very considerable size; two are generally placed side by side at the bottom of the cell.

I have examined many fragments of this fine species; but the only perfect specimen which I possess is of a compressed cup-shape, with the lamina gracefully curved and the margin sinuated. The cup is much flattened at one side; and on the other side, which is greatly produced, it widens out and then terminates in a pointed spout-like projection. The height is half an inch, and the width an inch. The form is a singularly elegant one, even for a Retepore; but in this genus the habit of growth is so variable that it cannot be relied on as a specific character.

3. ? *Retepora granulata*, Macgillivray. (Pl. XIX. figs. 13-15.)

Zoarium cup-shaped, thick. *Fenestræ* very small, oval or subrotund, much narrower than the very broad interspaces. *Zooœcia* rhomboid, flat, lined round, the surface covered with granules, which often form a border or edging round the upper margin of the mouth; orifice suborbicular, somewhat extended transversely; peristome not raised; frequently one or two small oval or subcircular avicularia placed transversely immediately below the inferior margin; many such avicularia scattered over the surface of the cells; numerous blunt and low mamillæ distributed over the zoarium, bearing on the upper side an avicularium with broad triangular mandible. *Oœcia* large, prominent, subglobose, surface granular, no fissure. *Dorsal surface* indistinctly vibicate, with scattered circular avicularia, sometimes absent.

Locality. South Australia.

This is probably the *R. granulata* of Macgillivray—though, in the absence of a sufficiently minute diagnosis of the latter, I hardly venture to identify the two with certainty. Amongst my specimens there is much difference in the degree in which the surface is granulated. In some cases the cells are almost smooth; in others the surface is thickly studded with small

glossy granules. Round the upper part of the orifice they are frequently of larger size, and are ranged in line and placed close together, so as to have much the appearance of rudimentary spines.

The ooœcium in *R. granulata* is described as "immersed and granular;" in my specimens it is closely united to the cells about it, and the base may be slightly immersed, but its striking characteristics are its massiveness and prominence. It stands out boldly from the surface of the cell, sometimes smooth, sometimes much roughened and bearing several of the small avicularia. The minute characters of the zooœcium and its orifice are not included in Macgillivray's diagnosis. In most of the cells of the form which I have in view an oval avicularium, set transversely, occurs immediately under the lower margin of the orifice, *placed towards one side.* Sometimes a second is present. Great numbers of similar avicularia are distributed over the cells, whilst the aviculiferous mamillæ, very different from the tall acuminate processes which occur on other species, thickly stud the surface of the zoarium. The inosculating branches are very thick and massive, and the meshes small and often suborbicular in shape.

Macgillivray describes the zoarium of his *R. granulata* as "expanded, foliaceous, convoluted." The habit of growth, as I have already remarked, has no specific significance in this tribe; but the fragments of the present species which I have examined show it to be caliculate and occasionally to form subcylindrical cavities.

4. *Retepora cellulosa*, Smitt *.

This species has a wide range. It occurs in the Arctic seas and in the Mediterranean, but has not been obtained, so far as I know, on our own coasts. Darwin took it off Cape Horn Macgillivray, a slender variety of it, in Australia; Hutton records it from New Zealand. I have a characteristic specimen from South Australia.

EXPLANATION OF THE PLATES.

Plate XVIII.

Fig. 1. *Retepora Couchii*, Hincks: natural size.
Fig. 2. The same.
Fig. 3. A portion of the zoarium, front surface, magnified.
Fig. 4. A portion of the zoarium, dorsal surface, magnified.
Fig. 5. A single zooœcium, magnified.
Fig. 6. One of the larger avicularia.

* Kritisk Förteckn. öfver Skandinaviens Hafs-Bryozoer, iv. (1868) pp. 84, 203, pl. xxviii. figs. 222–225.

Fig. 7. *Retepora plana*, Hincks: portion of the front surface, magnified.
Fig. 8. The same: portion of the dorsal surface, magnified.
Fig. 9. *Retepora robusta*, Hincks: a fragment of the zoarium, natural size.
Fig. 10. The same: portion of the front surface, magnified.

PLATE XIX.

Fig. 1. *Retepora monilifera*, Macgillivray: zooœcia, magnified.
Fig. 2. The same: a zooœcium in an earlier stage.
Fig. 3. One of the oral spines, magnified.
Fig. 4. One of the gigantic avicularia, magnified.
Fig. 5. Large elliptical avicularium, magnified.
Fig. 6. *Retepora prætenuis*, Hincks: portion of the front surface, magnified.
Fig. 7. The same: portion of the zoarium, magnified, showing the relative width of the fenestræ and the interspaces.
Fig. 8. Fragment of the zoarium, nat. size.
Fig. 9. *Retepora tessellata*, Hincks: front surface.
Fig. 10. The same: dorsal surface.
Fig. 11. The ooœcium.
Fig. 12. Fragment of the zoarium, nat. size.
Fig. 13. ?*Retepora granulata*, Macgillivray: front surface.
Fig. 14. The ooœcium.
Fig. 15. Two fenestræ magnified, showing the width of the interspace.

XLI.—*Descriptions of new Species of Heteropterous Hemiptera collected in the Hawaiian Islands by the Rev. T. Blackburn.*—No. 2. By F. BUCHANAN WHITE, M.D., F.L.S.

HAVING received from Mr. Blackburn information as to the habits, localities, &c. (as well as more examples of some) of the species noticed in my former paper (vol. xx. p. 110), it will perhaps be as well to give notes on these species before describing certain new ones since received.

In my last paper I omitted to number the species, which I will now do.

1. *Geotomus subtristis*, Buchanan White.

2. *Geotomus jucundus*, Buchanan White.

Both widely distributed and pretty common, living under stones and about the roots of herbage, and not confined to the mountains.

3. *Triphleps persequens*, Buchanan White.

Three specimens only found.

4. *Cardiastethus mundulus*, Buchanan White.

Not rare about the outside of roofs of houses.

5. *Nabis innotatus*, Buchanan White.

The specimen from which the description was made appears to be a pale form; in others the dark markings of the pronotum are more distinct, and the centre of the scutellum, as well as the two spots near the apex of the first vein of the corium, which are so frequently present in species of the genus *Nabis*, are more or less fuscous. On the whole, however, the name "*innotatus*" is not amiss.

Taken commonly by sweeping, but chiefly on the higher ground.

6. *Nabis subrufus*, Buchanan White.

Rare. Three specimens taken singly under bark on the higher mountains.

7. *Nabis? lusciosus*, Buchanan White.

Appears to vary in the intensity of the markings.

Not very common. Taken by sweeping, and also under and about bark on the higher mountains. The bark-frequenting propensity of this and the preceding species is, I think, very unusual in the genus.

8. *Luteva insolida*, Buchanan White.

Common everywhere, on the lower ground, in December.

9. *Merragata hebroides*, Buchanan White.

On small stagnant pools formed by the temporary overflow of streams on the higher mountains. When the pools dry up, the insect frequents the holes where the water has been.

10. *Corixa Blackburni*, Buchanan White.

Very common in salt-water pools on the sea-shore. These pools are formed artificially for the manufacture of salt. As the liquid becomes more dense by evaporation, the *Corixæ* migrate to pools more recently filled. Some would appear, however, to remain too long, as, in the last stage of evaporation, the pools generally contain a few dead *Corixæ*. Mr. Blackburn has hitherto failed to find any freshwater species of this genus.

Asopidæ.

11. *Œchalia patruelis*, Stål.

Arma patruelis, Stål, Freg. Eug. Resa, Ins. 220. 3.

This species, which has not been found elsewhere, is common on forest trees at no great elevation.

12. *Œchalia pacifica*, Stål.

Arma pacifica, Stål, *l. c.* 221. 4.

Like the last this is also peculiar to the Hawaiian Islands. Though widely distributed it is not common, and frequents trees on the mountains.

Lygæidæ.

13. *Nysius Dallasi*, n. sp.

N. oblongus, testaceo-flavescens, pallido-sericans; capite vitta laterali utrinque intra oculos et marginibus angustissimis vittæ pallidæ centralis, rostri apice, pronoto intra marginem anticum et macula utrinque prope angulos posticos, scutelli basi, tarsorum articulo primo, tertio apice unguiculisque, sterno maculis nonnullis, ventre vitta laterali utrinque marginem haud attingente et testaceo-maculata nigricantibus; antennarum articulo primo ad apicem exteriore, secundo apice et tertio basi, margine antico angustissimo corii, femoribus anticis maculis parvis, et tibiis apice, fusco-brunneis; membrana albido-hyalina. Capite cum oculis quam pronoti apex latiore; antennis gracilibus; rostro metasternum attingente, articulo primo bucculis paullo longiore; bucculis dimidio capitis fere æquilongis, retrorsum sensim humilioribus et evanescentibus; pronoto apice quam basi breviore, longitudine quam latitudine paullo minore, sat rude punctato, lateribus, impressione lineari antica et vitta media lævigatis, utrinque intra angulos posticos elevatos oblique sulcato; scutello punctato sat fortiter triradiatim rugoso; elytris basi parallelis, dein ampliatis et rotundatis; pedibus gracilibus, tibiis apice paullo incrassatis, tarsis posticis longis articulo primo articulis duobus ultimis ad unum multo longiore; ventris segmentis 3 apicalibus fœminæ angulariter emarginatis.

♀. Long. 5, lat. $1\frac{1}{2}$ m. m.

Not being closely allied to any of the species in Stål's 'Enumeratio,' its place is between that author's sections "*a*" and "*a a.*"

This species (which I have much pleasure in dedicating to Mr. W. S. Dallas, the founder of the genus *Nysius*, and whose 'List of Hemiptera in the British Museum' is so useful to all students of this order of insects) occurs rarely amongst mixed herbage near the summit of a mountain-pass known as the "Pali," near Honolulu.

14. *Nysius delectus*, n. sp.

N. suboblongus, dilute flavescenti-testaceus; antennarum articulo primo vitta externa et articulis 3 ultimis, rostri articulis 3 ultimis, capite (vitta centrali angustissima et tuberculis antenniferis exceptis), pronoto intra marginem anticum, punctis in disco, macula triangulari utrinque prope angulos posticos necnon margine

postico ante scutellum, scutello (lateribus apiceque exceptis), corii margine antico angustissimo, lineis interruptis ad venas, maculis nonnullis in disco, et margine apicali plus minus interrupto, clavi sutura commissuraque, femorum maculis sæpe confluentibus præsertim superne, tibiarum basi apice et linea angustissima ad marginem anticum, tarsorum articulo primo apice et articulo tertio unguiculisque, sterno (incisuris exceptis), abdominis marginibus posticis segmentorum 3 ultimorum saltem in medio, genitalibusque nigris vel piceo-nigris; antennarum articulo secundo apice imo pallido et articulo tertio apice dilutiore; oculis rufo-brunneis; membrana albido-hyalina. Capite cum oculis apice pronoti latiore, dense pallido-sericante; antennis sat gracilibus, articulo secundo tertio longiore, tertio quartoque æquilongis; rostro metasternum attingente, articulo primo bucculas superante; bucculis fere dimidio capitis æquilongis, retrorsum sensim humilioribus et evanescentibus; pronoto pallido-sericante rude punctato, vitta media, impressione lineari antica, lateribus, et angulis posticis lævigatis, sat brevi, margine antico quam margo posticus $\frac{1}{4}$ breviore, longitudine quam latitudo postica disdincte minore, margine postico utrinque intra angulos posticos elevatos sulca obliqua instructo; scutello pallido-sericante et rude punctato, ruga sat elevata lævigata; elytris parce sericantibus, basi parallelis, dein ampliato-dilatatis et sensim rotundatis; tibiis apice clavatis, tarsorum articulis primo tertioque apice incrassatis; margine exteriore calloso orificiorum auriculato-prominulo; ventris segmentis 3 ultimis fœminæ angulariter emarginatis; sterno ventreque dense pallido-sericantibus.

♂ et ♀. Long. 5–6, lat. 2–2½ m. m.

Somewhat allied to the preceding species, which, however, differs in its more slender form, longer and more graceful antennæ and legs, as well as in the coloration.

Widely distributed (but not very common) on the mountains, and generally taken by beating.

15. *Nysius arboricola*, n. sp.

N. oblongus, testaceus, nitidus, glaber; capite, rostri apice, vitta laterali utrinque, corpore subtus, scutelli basi lateribusque nigris; antennis totis dilute et articuli primi maculis obscurioribus, rostro apicem versus, oculis, callis transversis intra marginem anticum pronoti et angulis posticis, scutelli ruga callosa (apice imo excepto), corii venis, maculis 2 magnis triangularibus ad marginem apicalem et apice, femorum maculis nonnullis, tibiis apice imo, et tarsorum articulis apice plus minus brunneis vel fusco-brunneis; orificiis et maculis connexivi rufo-flavidis; membrana albido-hyalina. Capite ruguloso, cum oculis pronoti apice paullo latiore; antennis sat brevibus rostro brevioribus, articulo secundo tertio longiore; rostro metasternum attingente, articulo primo bucculis subæquilongo; bucculis basin capitis fere attingentibus, pone

medium retrorsum sensim humilioribus; pronoto rude punctato, callo transverso antico et angulis posticis subelevatis lævigatis, margine antico quam margo posticus paullo breviore, longitudine quam latitudo postica ¼ minore; scutello fortiter triradiatim calloso-rugoso, ad latera punctato; elytris fere a basi sensim rotundatis et subampliatis, sutura clavi distincte biseriatim punctata; pedibus subcrassis, tibiis apice et tarsorum articulis subclavatis.

♀. Long. 4, lat. 1¼ m.m.

Apparently allied in some respects to *N. helveticus*, H.-S. As yet rare, only two specimens having been taken. These were beaten from trees (one in May, the other in July), some miles apart, high up in the mountainous district.

16. *Nysius cœnosulus*, Stål.

Nysius cœnosulus, Stål, *l. c.* 243. 50.

The specimens which I refer to this species do not altogether agree with Stål's description, as the scutellum is only black in part, the apex of the second joint of the antennæ and the inner vein of the corium are not markedly dark, the mesosternum is sulcate, and the whole animal is more hairy. Still I think that they are properly referred here. *N. cœnosulus* is peculiar to the Hawaiian Islands.

Rather common on and about a small plant that grows in sandy places on the sea-shore.

17. *Pamera nigriceps*, Dall.

Rhyparochromus nigriceps, Dall. List, ii. 577. 47.

A common species on low plants and under stones &c., but not occurring below about 1000 feet above sea-level. This species is reported also from the Philippine Islands, Taiti, and New Zealand. The last-mentioned locality is on the authority of Dr. Mayr ('Novara' Hemiptera, p. 128); and I think it is just possible that a mistake may have occurred, though Dr. Mayr is so good a hemipterologist that I have much hesitation in suggesting this. The reasons I have for thinking there may be a mistake are these:—Dr. Mayr records *nigriceps* from New Zealand under the name *Plociomerus nigriceps*, with the remark that it seems to unite the characters of both *Paromius* and *Plociomerus*. *Paromius*, it may be mentioned, is synonymic with *Pamera* in part. Now there is a New-Zealand *Plociomerus* (which I have described under the name *P. Douglasi*) which very much resembles *Pamera nigriceps*, and which, if Dr. Mayr had only Mr. Dallas's description of the latter species (written when it alone was known) before him, it is not difficult to imagine that a mis-

take may have occurred. *Nigriceps*, however, distinctly belongs to *Pamera*, and *Douglasi* to *Plociomerus*. *Plociomerus Douglasi* is, moreover, a smaller and a darker-coloured insect.

18. *Clerada apicicornis*, Sign.

Clerada apicicornis, Sign. in Maillard, Notes sur l'île de la Réunion, Ins. 28, pl. 20. 8.

Taken by beating dead branches of a species of palm in mountain forests. This insect is rather widely distributed, occurring in Réunion, Bengal, Celebes, Cuba, and Venezuela. It is now recorded for the first time as a native of the Hawaiian Islands. In Walker's catalogue it is described from Celebes under the name *Gastrodes terminalis*; or, at least, the species so named is not separable by the description from *Clerada apicicornis*.

RECLADA, gen. nov.

Corpus anguste ovatum, depressum. Caput porrectum, thoraci fere æquilongum, ad oculos haud immersum, parte postoculari cylindrica, utrinque pone oculos ocellos ferente. Bucculæ elevatæ. Rostrum pedes anticos attingens, articulis primo et secundo ad unum parti anteoculari capitis subæquilongis, articulo secundo primo breviore. Antennæ articulo primo capite breviore, hujus apicem tamen superante. Pronotum transversum, trapezoideum, antrorsum angustatum, marginibus lateralibus acutis reflexis, medio levissime sinuatis, margine basali recto. Scutellum triangulare subæquilaterum, commissura clavi fere duplo longius. Hemelytra completa, margine costali leviter rotundato, margine apicali in medio sinuato deinde sensim sed distincte ad apicem commissuræ rotundato. Membranæ venæ haud bene discretæ. Pedes mediocres, femoribus inermibus, anticis vix incrassatis, tarsis posticis articulo primo apicalibus duobus simul sumptis longitudine fere æquali.

Genus *Cleradæ* Sign. maxime affine, structura rostri et hemelytrorum distinctum.

19. *Reclada mœsta*, n. sp.

R. obscure ferruginea, supra subtusque distincte et dense punctata; rostro, tarsis, membranaque pallidioribus; corii maculis in disco et ad marginem apicalem indistincte fuscis.

♂. Long. $3\frac{1}{3}$, lat. $1\frac{2}{3}$ m. m.

Rare. Circumstances of capture unfortunately not noted.

METRARGA, gen. nov.

Corpus ovato-oblongum, supra planum, subtus convexum. Caput subquadrilaterum, fere ad oculos immersum, antice compressum,

vertice valde convexo-elevato. Oculi parvi, retrorsum curvati. Ocelli prope basin capitis siti. Rostrum pedes posticos attingens, articulo primo capiti æquilongo. Antennæ dimidio corporis æquilongæ; plus dimidio articuli primi apicem capitis superans; tubercula antennifera extus valde spinosa. Pronotum transversum, angulis anticis prominulis, marginibus lateralibus carinatis subacutis in medio sinuatis, angulis posticis calloso-prominulis, basi fere recta. Scutellum paullo longius quam latius, leviter elevato-marginatum. Hemelytra completa, margine antico rotundato, explanato et subreflexo, margine apicali angulum interiorem versus fortiter sinuato, angulo exteriore producto. Pedes mediocres, coxis posticis haud remotis, femoribus inermibus vix incrassatis, tarsis posticis articulo primo duobus ultimis simul sumptis fere æquilongo. Ventris segmentorum omnium margines postici recti et latera attingentes, spiraculis tribus ultimis in ventre sitis, ceteris obscuris.

Type *M. nuda*, n. sp. Affinity doubtful.

20. *Metrarga nuda*, n. sp.

M. fusco-brunnea, capillis brevissimis depressis parce vestita; pronoti linea centrali subelevata et angulis posticis, scutelli apice imo, pedibusque albido-testaceis, his piceo-nigro annulatis; antennis rostroque pallide rufo-brunneis, illis articulo primo basi apiceque et articulo secundo apice dilutioribus, hoc apice nigro; oculis rufo-brunneis; corii margine antico vitta latissima indeterminata irregulariter albido-testaceo maculata, margine imo hinc illinc piceo-notato; membrana fusca maculis plurimis parvis pallidis notata. Capite pronotoque dense et sat rude punctatis; tuberculis antenniferis extrorsum dente acuto instructis; antennarum gracilium articulo primo sat crasso leviter curvato, articulo tertio secundo paullo breviore, quarto fusiformi; pronoti linea media subelevata, impressione lineari antica et angulis posticis lævigatis, angulis anticis dentato-prominulis, lobo antico ad latera subdepresso, marginibus lateralibus in medio sinuato-emarginatis, margine antico quam basis paullo breviore; scutello fortiter punctato, apice lævigato, basi depresso, ruga longitudinali subelevata instructo; elytris apicem abdominis paullo superantibus dense sed subtiliter punctatis, membrana venis 5 instructis, vena quarta furcata; pedibus sat brevibus haud gracilibus; sterno rude punctato.

♂. Long. 8, lat. pone medium $4\frac{1}{2}$ m. m.

Only two specimens found, and the circumstances of capture not noted.

21. *Metrarga villosa*, n. sp.

M. obovata, testaceo-brunnea, villis brevibus depressis dilutioribus densissime vestita; capite nigro, clypeo et tuberculis antenniferis pallidis; antennarum articulo secundo rufo-brunneo basi apice-

que dilutioribus, tertio quartoque fusco-brunneis; rostro apice nigro; elytris irregulariter fusco-brunneo notatis, margine antico distinctius maculato; membrana fusca; pedibus albido-testaceis fusco-nigro annulatis, tarsis fusco-brunneis. Capite subtiliter punctato, tuberculis antenniferis extrorsum dente subobtuso armatis; antennarum articulo primo sat crasso, secundo tertioque subæquilongis, quarto fusiformi; pronoto subtiliter punctato, impressione lineari antica et angulis posticis lævigatis, marginibus lateralibus sinuatis antice elevatis, margine antico in medio calloso-tuberculato ad latera depresso, disco utrinque callo longitudinali instructo, basi apiceque fere æquilatis; scutello rude punctato, basi media depresso, ruga longitudinali elevata instructo; membrana parva apicem abdominis haud superante, pone apicem corii parum extensa, venis haud bene discretis; sterno punctato.

♂. Long. 5-5½, lat. pone medium 2½-3 m. m.

Apart from its villosity and smaller size, the different structure of the pronotum and of the membrane at once distinguishes this from the preceding species.

Not rare among rotten leaves &c. at the foot of a precipice on the mountains five or six miles from Honolulu.

Capsidæ.

22. *Capsus pellucidus*, Stål.

Capsus pellucidus, Stål, *l. c.* 255. 92.

A common species, but peculiar to the Hawaiian Islands.

Anthocoridæ.

23 *Cardiastethus sodalis*, n. sp.

C. rufo-brunneus, capillis pallidis vestitus; oculis et lobo postico pronoti nigro-piceis; antennis, pedibus elytrisque luteo-brunneis; clavi apice cuneoque præsertim ad apicem brunneo-fuscis; antennarum articulis secundo apice, tertio quartoque, capite inter oculos, membranaque fuscis.

Long. circa 2½ m. m.

Rather closely allied to *C. rufescens*, Costa (= *testaceus*, Perris), which, however, is larger and differently coloured; much more closely related to *C. bicolor*, Buchanan White, from St. Helena. *C. bicolor*, however, is a shade larger, more evidently punctate and more thickly clothed with hair, and differs besides in the colour of the anterior lobe of the pronotum and scutellum and in the markings of the elytra.

Not very common, about the outside of the roofs of houses in company with *C. mundulus*.

Acanthiidæ.

24. *Acanthia lectularia*, L.

An introduced species, and far too common.

Saldidæ.

25. *Salda exulans*, n. sp.

S. nigra, subnitida, brevissime nigro-grisco pubescens; maculis 2 parvis anticis capitis, rostro, antennarum articulo basali (apice excepto), pronoti marginibus angustis lateralibus (margine imo et angulis posticis exceptis), marginibus acetabulorum pedibusque (coxis basi, femoribus tibiis tarsisque apice exceptis), clavi macula pone medium, corii margine antico lato, maculis 2 et linea longitudinali inter marginem et venam primam, illius interne linea ad dimidium apicale, maculis 3 et dimidio apicali marginis interioris, necnon membranæ areolis 3 exterioribus plus minus sordide brunneo-albidis. Capite quam apex pronoti latiore; pronoti latitudine postica quam longitudo media triplo majore, margine postico quam margo anticus plus duplo longiore, callo antico mediocri in medio foveolato, marginibus lateralibus rectis, margine postico late et sat profunde sinuato ante scutellum; scutelli depressione media mediocri; elytrorum margine antico distinctissime rotundato; membrana parva, areolis 4 instructa; antennis pedibusque gracilibus; alis brevibus.

♂. Long. 4, lat. pone medium 2 m. m.

Belongs to section *e* of Stål's 'Enumeratio,' and is remotely allied to *S. coxalis*, Stål.

Sparingly in wet moss in one place on the mountains near the "Pali."

Nabidæ.

26. *Nabis Blackburni*, n. sp.

N. elongato-oblongus, griseo-testaceus, parce pallido-pubescens; capite vitta medio latiore, pronoto cicatriculis anticis vittulaque disci longitudinali, in collo latiore quam in lobo postico et in lobo antico fere geminata, fusco-nigris; lobo postico pronoti utrinque striis 3 subobliquis obsolete fuscescentibus, exterioribus angulum posticum versus distinctioribus; abdominis dorso nigro-fusco; capitis lateribus subtus, sterni vitta laterali et maculis in medio, ventrisque vitta lata laterali aliaque angustiore media nigris; antennis pedibusque corpori concoloribus, antennarum articulo secundo apice nigro, articulis duobus ultimis fusco-brunneis; femoribus maculis plurimis et lineolis transversis, tibiis punctis indistinctis, tarsorum articulis apice fusco-brunneis; elytris apicem abdominis paullo superantibus grisco-testaceis, costis dilutioribus irregulariter fusco-cinctis, interstitiis hinc inde

fusco-brunneo maculatis, corii vena exteriore maculis duabus nigro-fuscis; membrana griseo-hyalina venis latis permultis fuscis, basi extus puncto nigro notata; connexivo pallido stria interiore longitudinali sanguinea notato. Capite pronoto breviore; antennarum articulo primo capite breviore; femoribus anticis capite et pronoto simul sumptis brevioribus; pronoto postice sat fortiter ampliato, basi fere æque lato ac longa.
♂. Long. 7½–8 m. m. Abdomen vix duplo longius quam latius.

Allied to *N. punctipes*, Reuter, but differing by its larger size, and in other respects as noted above.

Common amongst long grass in damp hollows on the higher mountains.

Veliidæ.

27. *Microvelia vagans*, n. sp.

M. fusco-nigra, pilis brevissimis fusco-brunneis densissime vestita; pronoti margine antico macula latera haud attingente, et margine postico, necnon connexivo (margine imo excepto) luteo-fulvis; antennarum articulis duobus primis fusco-brunneis, primo basi dilutiore et apice obscuriore; pedibus obscure fusco-brunneis, femoribus dimidio basali fusco-lutescentibus; capite utrinque ad oculos vitta angusta capillorum argenteorum instructo; clytris brunneo-fuscis, venis obscurioribus, maculis 5 vel 6 plus minus albidis notatis; corpore subtus nigro, pilis argenteis vestito.
♂ et ♀. Long. 3–3½, lat. 1 m. m.

Not uncommon on running water.

XLII.—*Descriptions of new Species of Birds from the Island of Lifu, New Caledonia.* By E. L. LAYARD, C.B., H.B.M. Consul, Noumea, New Caledonia.

Turdus Pritzbueri, Layard, n. sp.

♂. Entire head, chin, throat, upper part of cheek very pale sepia; the whole of the rest of the body, above and below, very dark sepia, some of the feathers of the abdomen having paler sepia edges. Bill, feet, and legs pale yellow.

♀ like the ♂, but the crown of the head and lower portion of the chest brownish, and general colour of body not so dark.

Juv. Top of the head brown, spotted with rufous; underparts deep rufous, spotted and irregularly marked with small broken bars of dark sepia.

♂. Length 8″, wing 3″ 7‴, tail 3″ 3‴, tarsi 1″ 2‴·25, bill 13‴.

Hab. Lifu, New Caledonia.

Pachycephala Littayei, Layard, n. sp.

♂. Upper three fourths of head jet-black; chin and throat pure white, succeeded by a broad black collar; all the rest of the lower parts rich gamboge-yellow; upper plumage yellowish green; wing- and tail-feathers greenish brown, the former edged externally with yellowish green.

Length 7″ 6‴, wing 3″ 10‴, tail 3″ 2‴, tarsi 13‴, bill 12‴.

♀ unknown.

Hab. Lifu, New Caledonia.

Zosterops minuta, Layard, n. sp.

Upper parts all a bright yellow tinged with green, brightest on the front of the head; forehead, as far as the eyes, bright yellow; eyelids white, as usual, but with a narrow black line under the lower lid; chin, throat, breast, abdomen, and under tail-coverts bright yellow; flanks and sides of abdomen buff; wing- and tail-feathers grey-brown, edged with bright greenish yellow.

Length 3″ 8‴, wing 2″ 1‴, tail 1″ 6‴, tarsi 8‴, bill 6‴.

Hab. Lifu, New Caledonia.

Zosterops inornata, Layard, n. sp.

Head dull green; black dark sepia, faintly tinged with green. No white eyelid visible. Wing- and tail-feathers same as the back, but edged on the outside with green; chin greyish; throat and breast dirty greenish. Sides of breast sepia-brown; flanks inclining to buff. Abdomen pale sepia. Upper mandible dark brown; lower pale. Bill very strong and sharp-pointed.

Length 5″ 6‴, wing 3″ 1‴, tail 2″ 4‴, tarsi 11‴, bill 11‴.

Hab. Lifu, New Caledonia.

Its sombre lining renders this bird difficult of description; but on comparison with any other species the differences are very marked.

Erythrura cyanofrons, Layard, n. sp.

General colour above and below green, rather lighter than in *E. psittacea*; rump, upper tail-coverts, tail-feathers dull scarlet, not nearly so bright as in *E. psittacea*. Two central tail-feathers elongated. Forehead and cheeks bright blue, and a black mark over the lores. Bill black.

Length 5″, wing 2″ 3‴, tail 2″ 3‴, tarsi 7‴, bill 6‴.

Hab. Lifu, New Caledonia.

XLIII.—*Emendatory Description of* Purisiphonia Clarkei, *Bk., a Hexactinellid Fossil Sponge from N.W. Australia.* By H. J. Carter, F.R.S. &c.

In the month of May 1869 the late Dr. Bowerbank published a description, with microscopic structure, of a fossil hexactinellid sponge from N.W. Australia, to which he gave the name of *Purisiphonia Clarkei*, after the Rev. W. B. Clarke, F.G.S., who found the specimen at Wollumbilla in Queensland (Proc. Zool. Soc. 1869, p. 342, pl. xxv. figs. 6 and 7); and in May 1870, Charles Moore, Esq., F.G.S., gave a figure of the entire specimen, with Dr. Bowerbank's description ("Australian Mesozoic Geology and Palæontology," Quart. Journ. Geol. Soc. vol. xxvi., May 1870, p. 235, and pp. 240–242, pl. xvii. fig. 1).

In October 1877, while going over some of the late Dr. Bowerbank's collections, I found a specimen of this sponge, and, not having observed any allusion to it in Prof. Zittel's "Studien über fossile Spongien" (Hexactinellida), transl. 'Annals,' 1877, vol. xx. p. 257 *et seqq.*, I mentioned the fact to him, which he acknowledged to be the case, and suggested my writing a new description of *Purisiphonia Clarkei*, for which he kindly supplied me with the references.

It was not, however, until February 1878, that I obtained Mr. Moore's address, when he informed me that the original specimen had been sent back to Sydney, but that he had two small portions of it, which, together with a copy of his paper, he subsequently forwarded to me. Thus with the three fragments, each of which is about two inches square and the whole thickness of the sponge, viz. about half an inch, I have, together with Mr. Moore's figure, every thing that is necessary for description, saving the figure of the sponge *entire*, which, if yet found, has never been published.

Purisiphonia Clarkei, Bk.

Fossil siliceous. Entire specimen consisting of an irregular triangular portion about 4 inches square and half an inch thick, more or less curved, so as to give the idea of having once formed part of a hollow sponge, which had grown out here and there into processes, as indicated by three large holes (one of which is 2 inches in diameter), whose external edge, respectively, is raised above the common level of the specimen, indicative not only of the outside of the sponge, but of its having grown outwards in this direction. What these processes were like, viz. whether short or long, open or closed, the specimen does not reveal. Colour ochre-yellow,

where the structure is still filled with siliceous grit, but whitish grey where it has been emptied by means of acid of the calcareous material that originally filled this part (Moore, *l. c.* p. 235). Surface undulatory on both sides. Pores, which are organs of the sarcode, of course, in like manner, absent. Oscules very numerous, averaging $\frac{1}{10}$ inch in diameter and about the same distance apart, more or less regularly disposed over each surface, expanded at the outlet, and bridged over by reticulated spiculous structure, which divides the subjacent large aperture into several smaller ones, and in some instances, from its regularity, presents a septate or stelliform figure; followed by their respective canal-systems, which, descending vertically and branching out towards the opposite sides of the sponge, end just under the surface in the intervals between the oscules; thus the excretory canal-systems, connected with the oscules on one side, terminate on a level with the oscules on the other side of the sponge, and *vice versâ*, where probably, in the living state, the pores of the dermal sarcode opened into them: sometimes two systems may be seen, side by side, reversed in this way. Internal structure made up of straight spiculiferous bundles, averaging half an inch in length, which cross each other at different angles in all directions, in the midst of minute vitreous reticulation, the whole cemented together into a common mass by silicified sarcode, traversed by the excretory canal-systems above mentioned. Spiculiferous bundles composed of fine, smooth, long, linear spicules, arranged parallel to each other, and surrounded generally by silicified sarcode, or united together in smaller bundles, separately, by the silicified sarcode being disposed in the form of transverse bars, so as to present a ladder-like appearance. Reticulated structure consisting of small sexradiates, united arm to arm and to the spiculiferous bundles by the silicified sarcode, which is more or less spined throughout, and the spines in some instances multifid. Spicules, for the most part, replaced by an axial cavity in the spiniferous silicified sarcode, which, in many parts of the skeleton, is thus rendered more or less continuously canaliculate. Rosette globular, radiate; rays capitate, about 1-3000th inch in diameter. Smallest sexradiate seen in the reticulated structure 1-75th inch in diameter.

Hab. Marine.

Loc. Upper Oolite or Cretaceous system, in boulders with marine shells, "not uncommon" (Moore, *l. c.* p. 235). Wollumbilla Creek, Queensland, N.W. Australia.

Obs. As the specimen of *Purisiphonia Clarkei* above described is so imperfect, I prefer the term "hollow" to that of

"fistulous," used by Dr. Bowerbank (*l. c.*), since the latter implies a form which we are not justified in giving to the only fragment of this sponge brought before the public, even if, when entire, it could under the circumstances be called "fistulous." That the curved state of the specimen indicates a concavity, and that the large holes in its surface indicate growth in these directions respectively, with a wall averaging half an inch in thickness throughout, is all that can be said towards a description of the *entire* form, whatever this hereafter may prove to be; but the forms of the same sponge are often so varied, that the next specimen may in this respect be totally different from the present one. In general structure (which, where the calcareous infiltration has been dissolved out by acid, is as beautiful and perfect almost as it ever could have been) *Purisiphonia Clarkei* is somewhat like the specimen of *Dactylocalyx pumiceus*, Stutchbury, in the British Museum—that is, in the general thickness of the wall and the arrangement of the excretory canal-systems (this specimen is circular, flat-vase-shaped, 17 inches in diameter, and about an inch in thickness),—but in the minute structure totally different, as it is from the structure of all other hexactinellids with which I am acquainted, inasmuch as the bundles of linear spicules, cutting each other in all directions at different angles in the midst of the reticulated structure, are entirely absent in *D. pumiceus*; and although somewhat resembling those of *Euplectella aspergillum*, and similarly united by ladder-like structure, they are comparatively short and arranged in a totally different manner, never apparently crossing each other at right angles. It is true that, where the spiculous structure bridging the oscules is rubbed off, the surface presents the lattice-like appearance of *Euplectella*; but this is in an unnatural state, while the rest of the structure of the wall, together with its thickness, resembles that of *D. pumiceus* rather than that of *Euplectella*.

By chance I found, under $\frac{1}{4}$-inch compound power, a microscopical fragment of the skeleton bearing a rosette, which I now possess, mounted in balsam; and this, as above stated, is globular, radiated, like that of *Dactylocalyx subglobosus* and also *D. pumiceus* ('Annals,' 1873, vol. xii. pl. xiii. fig. 6). It is the only instance in which I have found a rosette fossilized; and but for the unusually perfect state of the decalcified skeleton, chance, and the use of a high microscopic power, this, in all probability, would never have occurred. Still it shows that the rosette may be preserved, although the combination of circumstances necessary for its detection may seldom happen. The presence of this globular *radiated* form of rosette, how-

ever, seems to point out that *Purisiphonia* did not belong to the *Euplectellidæ*, nor to the hexactinellids with scopuliform spicules, as in all these, so far as my observation extends, the rays of the rosette are arranged *en fleur-de-lis*.

Lastly, we learn from Mr. Moore's paper that specimens of this sponge are not uncommon in the calcareous boulders which are found in the "brittle marl" of the Creek of Wollumbilla, and among the "grits and sandstones" of the neighbouring plains, indicating, from the other fossils which they contain, and their worn state, that such boulders belong to a drift deposit, and originally came from Upper-Oolitic and Cretaceous strata, which have previously existed in Australia in their entirety, if this be not the case now, in some parts as yet undiscovered.

XLIV.—*Notes on the Internal and External Structure of Palæozoic Crinoids.* By CHARLES WACHSMUTH *.

THE structure of fossil Crinoids has occupied the attention of many able writers; and numerous ingenious and plausible theories have been advanced to demonstrate the physiological functions of the various parts of their complicated organization. The results of investigations heretofore made have been by no means harmonious; and newly discovered evidence renders many of these theories wholly unsatisfactory. I have been favoured with unusual facilities for obtaining accurate knowledge upon many of the questions involved in these researches, and therefore hope that I may contribute useful information on the subject. The collections of eighteen years at Burlington, Iowa, have brought to light material, unrivalled elsewhere, for this study. I have obtained upwards of four hundred species of Crinoids at that locality, many of the specimens in such a condition that not only the whole calcareous skeleton of the animal, but even the most delicate internal organs are preserved almost as perfectly as in those dredged from our present seas. Careful observations, extending through many years, and study of this material in connexion with extensive collections from other formations, have enabled me to add to the present knowledge of these forms many interesting and important facts, and have led me to conclusions which I present in the following pages.

1. *The Mouth and the Tubular Skeleton below the Vault.*

The apparent absence of a mouth has proved to be one of

* From 'Silliman's American Journal,' August 1877.

the most perplexing points in the investigation of the structure of Palæozoic Crinoids. In all Radiates (even of the most inferior groups) this organ is located invariably *at one end of the vertical axis*, although that axis or centre is not always the centre of figure. It occupies in the recent Crinoids the upper end of this axis; but in many at least of the Palæozoic Crinoids, the portion of the summit where, from analogy, we should expect to find the oral aperture is perfectly covered by solid and immovable plates. The only aperture in connexion with the visceral cavity is lateral or subcentral, placed outside of the radiation and within the interradial area, where, from analogy, we must expect to find the anus. If, as Mr. Billings*, Dr. White†, and the older writers on Crinoids supposed, this aperture served both as mouth and vent, so that these Crinoids took in their food through the anus, this stands as the sole exception to the rule governing the class. It is true the Ophiurans, for instance, have no separate anal opening, and the same aperture performs both oral and anal functions; but it is placed within the radial centre, and therefore cannot be homologized with the interradial orifice of Palæozoic Crinoids. In *Antedon rosaceus*, although the nascent Crinoid develops already within the pseudembryo a separate mouth and vent, a single orifice serves for some time both as oral and anal aperture; yet it is the permanent mouth, occupying the centre of the ambulacral system‡. While we thus find the mouth performing permanently or temporarily anal functions, we have on the other hand no evidence, either from recent nature or from embryology, that an anus ever becomes developed into, or performs the office of, a mouth.

The Crinoids of our present seas live exclusively on microscopic food; and we must expect to find that the Palæozoic Crinoids subsisted upon very similar food and had a very similar mode of alimentation. Whenever in *Antedon* alimentary particles fall upon the furrows of the arms or pinnulæ, they are transmitted downward along these furrows to the mouth wherein the furrows terminate. Dr. Carpenter remarks on this subject §:—

"The transmission of alimentary particles along the ambulacral furrows is the result of the action of cilia with which their surface is clothed. Although I have not myself suc-

* Silliman's Journ. 1869, vol. xlviii. no. 142, p. 69.

† Journ. Nat. Hist. Boston, 1862, vol. vii. no. 4. p. 481.

‡ Sir Wyville Thomson, Phil. Trans. of the Royal Society.

§ "Researches on the Structure, Physiology, and Development of *Antedon rosaceus*.—Part I.," by W. B. Carpenter, M.D., F.R.S. (Phil. Trans. Roy. Soc., vol. clvi. part 2, 1866).

ceeded in distinguishing cilia on the surface which forms the floor of these furrows, yet I have distinctly seen such a rapid passage of minute particles along their groove as I could not account for in any other mode, and I am therefore disposed to believe in their existence. Such a powerful indraught, moreover, must be produced, about the regions of the mouth, by the action of the large cilia which fringe various parts of the internal wall of the alimentary canal, as would materially aid in the transmission of minute particles along those portions of the ambulacral furrows which immediately lead toward it; and it is, I feel satisfied, by the conjoint agency of these two moving powers that the alimentation of *Antedon* is ordinarily effected."

It appears from these observations that the mouth of *Antedon* has no special functions as such, but is merely a receiving centre or general passage, into which the food which accidentally falls into contact with the furrows of the arms or pinnulæ enters—a passage which might as well be external, hidden beneath a vault, as open to the surrounding element, provided the food could be brought into contact with it. The large cilia on the inner wall of the alimentary canal, which Dr. Carpenter describes as being capable of producing such a powerful indraught to the region of the mouth, afford, it seems to me, also a very satisfactory explanation of the mode by which the transmission of food was effected in Palæozoic Crinoids. How much more powerful must have been the effects of these cilia in individuals in which mouth and furrow were arched over and in which the current was unobstructed from without! Considering, further, that probably the covered parts of the food-channels themselves were fringed with cilia of similar functions, it could have been of but little moment how remote from the mouth the food entered. We find another most striking example in confirmation of this supposition in *Hypomene Sarsi*, Lovén, a recent Cystidean, indicating, in analogy with recent nature, that Crinoids had the mouth sometimes internal. Prof. Lovén found in the covered parts of its channels microscopic Crustacea, larval bivalves, and other remains of the food of the animal, apparently taken through the open parts of the channels. Applying this observation to Palæozoic Crinoids, it seems very probable that their food was taken up along the open parts of the arms or pinnulæ, and conveyed through the closed parts to the concealed mouth.

Dr. Ludwig Schultze, in his excellent 'Monograph on the Echinoderms of the Eifel' (Vienna, 1867), was, so far as I know, the first author who suggested the idea that all Crinoids which are covered on their ventral side by solid plates, and have but one orifice, were provided with an internal

mouth. He further suggested that the food was conveyed by the open food-groove to the inner cavity through the arm-openings at the base of the arms, by means of subtegminal channels along the inner surface of the vault.

Dr. Lütken, fully confirming Dr. Schultze's observations, gives a full description of the ducts and subtegminal galleries, and compares these with the covered food-grooves in *Hypomene Sarsi*, expressing the opinion that the galleries underneath the summit, which he considered to be closed at the bottom and thus transformed into ducts, were food-passages.

Meek and Worthen describe and figure, in the Illinois Geological Report, vol. v., from my former collection, now in the Museum of Comparative Zoology at Cambridge, several specimens of well-preserved digestive organs, and also an *Actinocrinus proboscidialis*, in which a skeleton of tubular canals proceeds from a point below the central axis of the vault to the arms. There are in that specimen five main tubes which bifurcate midway toward the arm-bases, each division bifurcating again, sending a branch to each one of the twenty arms of that species. The main tubes and branches are constructed on their lower side of alternating plates, upon which, on either side, a second row of minute quadrangular interlocking plates is attached, longitudinally arranged, thus covering the tubes. The upper rows of plates are not preserved in this specimen; but I have found them in two specimens of *Strotocrinus*, which I obtained recently, in which they are well preserved and in place. The condition of the specimen, as Meek and Worthen remark, leaves but little doubt that the tubes form through the arm-openings of the calyx a continuation of the arm-furrows. In removing parts of the vault, I unfortunately broke the upper part of the fragile skeleton; but enough is preserved to prove that the five main tubes did not connect directly with each other, but communicated at their upper end (separately, as it seems) with an annular vessel of which traces are yet preserved. Such a vessel was found in wonderful preservation in a specimen of *Actinocrinus Verneuilianus*, Shum. The radiating canals were here not preserved; but the little openings through which they communicated are plainly visible in the circular organ. There are, at the lower side of the ring, which is composed of minute interlocking plates, five other small openings, which, alternating with the former ones, were apparently in connexion with organs of the interradial system (communicating perhaps with a circulatory system). The whole upper part of the stomach is here placed within the ring—differing in this particular from *Actinocrinus proboscidialis*, in which only a spiral alimentary tube passes out from

the interior of the convoluted digestive organ. The several tubes of the skeleton, though closely following the direction of the vault, but without touching it, are placed here within some obscure furrows along its inner surface.

Such furrows in the vault can be observed in many Palæozoic Crinoids. They are either elevations of the vault itself or are formed by ridges or partitions on the inner surface, which are always deepest toward the anal side. The grooves are sometimes closed underneath, particularly in very old specimens, thus forming regular ducts or tunnels. Their arrangement seems to be similar in all these Crinoids, no matter whether the species has a subcentral proboscis or merely a lateral opening; they always diverge from a plane on the inner wall of the vault, in front of the anus, and branch to the arm-openings.

For further information on this subject, I will now call attention to some most excellent natural casts, mostly of Actinocrinidæ, which I obtained from cherty layers of the Upper Burlington Limestone. The outer shell or limestone test was generally attached when I found them, but so much decayed that it was removed by the least touch. The substance of which the casts are formed appears to have been a fine siliceous mud which could penetrate the smallest pores. The internal organs are of course not preserved; but their impressions at the surface of the casts throw much light on the structure beneath the vault. The centre of radiation appears here a small pentagonal, rounded, or, in species with strong subcentral proboscis, subtriangular or even heart-shaped space or plane, enclosed by a deep groove, from which, in some of these specimens, elevated ridges, alternating with depressions, pass out toward the arms; but before quite reaching them, there proceeds, from below the ridges of the casts, to every arm a smaller ridge which clearly indicates the tubular canal, as described in *Actinocrinus proboscidialis*. The casts are so perfect that I can even detect at some places the impressions of the alternating minute plates of the tubes.

The casts are easily understood, if we remember that the broader ridges are impressions of the grooves in the vault, and that the depressions correspond to the partitions which formed the grooves. The radiating tubes, where they do not appear in the casts, were evidently placed at some distance from the vault, and therefore enveloped and obliterated by the material forming the casts; but on approaching the arm-bases they closely underlie the test and their counterparts are preserved.

I have already mentioned in the casts a pentagonal space,

surrounded by a furrow, as being the centre of radiation. It is located anterior to the proboscis, occupying a central or nearly central position. The middle of the space is occupied frequently either by a small opening or by a little cone indicating an aperture leading toward the inner cavity; but in these casts the aperture is isolated, and there appears on the surface no connexion with the annular groove surrounding it. To understand this structure it becomes necessary to examine first some other casts from the same locality, mostly of *Strotocrinus* and *Actinocrinus*, but also several of *Batocrinus*, though of different species from those which I have just described. These casts have no annular groove; and the radiation, which is marked by elevated rounded ridges, almost like strings overlying the surface, proceeds from *a point in the centre where I noticed the little aperture* in the former casts. The strings diverge toward the arm-bases in the same manner as the tubular canals; they are stronger toward the centre, decreasing in size with each bifurcation. That these ridges are remains of muscular cords is not probable, from the perishable nature of such organs; and they are not their casts, or they should have left depressions in place of elevations. They can only be casts of passages which communicated with the central aperture, and which were evidently yet preserved when the siliceous mud, forming the casts, penetrated the body; but their calcareous parts becoming in the course of time decomposed, a cast was left only of their inner channel; and this explains their string-like appearance. The little central aperture, located at the upper end of the vertical axis, occupied on the casts, and hence below the vault of these Crinoids, exactly the same position that *the internal mouth of* Antedon *occupies at the peristome*; while the position of the string-like ridges (in case they represent passages, as I can hardly doubt) is analogous to that of the *open food-grooves* of recent Crinoids.

The annular groove on the casts is probably an impression of the annular *vessel*, of which the calcareous parts have decomposed. This organ, in the fossil state, heretofore only observed in the case of *Actinocrinus Verneuilianus*, existed undoubtedly in all Crinoids. That we find no trace of it in some of the casts is no proof to the contrary; it may have been sometimes composed of more perishable material and therefore not preserved, or situated at a greater distance from the vault and covered by the substance of which the casts were formed.

2. *The Ventral Furrow of the Arms.*

The arms of Palæozoic Crinoids manifest great diversity in outer form and structure, but are invariably provided with a

ventral furrow, which continues from the arm-bases up to the tips of the arms and along the pinnulæ. The pinnulæ spring out alternately right and left from the arm-plates, their furrows connecting with that of the arm and forming, in fact, a continuation of the same.

The furrow appears, in specimens in ordinary preservation, as a simple groove, which communicates through the arm-openings with the inner cavity of the body. Only in rare instances has the furrow been found covered by minute plates, whose construction, however, has heretofore not been ascertained. The best specimen of this kind that I have seen is a *Cyathocrinus malvaceus*, in which the little plates above the furrow can be studied in all their details with the greatest precision. The specimen is the property of Frank Springer, Esq., who had the kindness to leave it with me for investigation and description. The arms of *Cyathocrinus* are composed of long slender joints with a wide ventral furrow. They bifurcate frequently, each branch bifurcating at intervals again. There appears on the arms of *Cyathocrinus* no scar for the attachment of pinnulæ; and as these appendages have never been observed in the genus, it is probable that the many little branches performed their functions. In Mr. Springer's specimen the plates above the furrow consist of two rows of minute pieces on either side, the inner rows of which join in the middle, interlock with each other, and form an apparently solid covering. The outer plates which are attached to the arm-joints are toward the upper end of the arms placed partly upon the edges of the joint, but nearer the calyx rest wholly against the edges of the upper part of the ventral furrow. They are longitudinally arranged, partly hidden from view by the inner plates. The visible part is quadrangular, with a narrow tooth-like projection toward the lower end of each plate, which is directed inward and slightly downward as a sharp, elongated process, and forms a support for the inner plates. The inner plates are elongated triangular, resting with their shorter sides against the inner faces of the outer series, and, between the tooth-like extensions, overlapping them with their bevelled lateral edges, in such a manner that each plate exteriorly fits in and fills the space between each pair of similar triangular plates on the other side. The two longer sides interlock with corresponding sides of similar plates of the opposite row, their sharp angles or apices meeting the sutures between the opposite quadrangular plates. At each of these points of junction, just beyond the apex of each triangular piece, on either side of the furrow, there is a little pore, which evidently communicates with the inner channel. There are

six sets of plates to each arm-joint, all the plates being imbricated from the lower side upward (that is, the lower ones overlap slightly the edges of the upper ones), thus facilitating the movements of the arms.

In describing the skeleton below the vault, I suggested that the tubes were a continuation of the arm-furrows. A transverse section of the arm, examined with the aid of a good magnifier, shows that the tubes themselves were, at least in this species, continued along the arms to their tips and rested within the arm-furrow, with their sides closely attached to the upper edges of the arm-joint. The tubes do not touch the floor of the arm-grooves, but leave a good-sized subtriangular channel underneath. The small plates, above described, form the upper or outer wall of the tube; and two sets of small plates enclose it below. The position of the two upper sets of quadrangular pieces is nearly erect, leaning inward, the triangular cross pieces lying horizontally, thus forming a regular tube or tunnel with a nearly round channel.

I was at first of the opinion, after examining Mr. Springer's specimen, that the arm-furrows of Palæozoic Crinoids were permanently covered by solid plates, like the ventral side of their cup; but upon comparing these arms with those of a specimen of *Cyathocrinus viminalis* in my own collection, I became fully convinced that the inner plates could be opened or shut at will by the animal. The arms of my specimen are spread out; their ventral furrows are open, the quadrangular pieces in place; their tooth-like extensions stand out like the teeth of a saw, and are so arranged that the indentations face the salient angles of the opposite side, thus giving to the furrow a strongly zigzag appearance.

The tooth-like processes in this species are so prominent that, from their similar form, and before I had recognized this peculiar structure in Mr. Springer's specimen also, I at first took them for the triangular cross pieces; but on closer inspection I found no sutures between the projections and the quadrangular portions of the plates; and as the place of attachment for the triangular pieces is plainly visible, there can be no doubt that these plates were not preserved in the specimen. Furthermore, as the quadrangular pieces are with slight interruptions found on all the arms of the specimens most beautifully preserved, it seems almost impossible to understand how the triangular pieces could have fallen out, if they had been fastened solidly to the adjoining plates. Supported by the tooth-like projections, and resting against the edges of the quadrangular plates, they were evidently better protected than the outer pieces; and it seems to me their destruction would

have involved that of the entire covering. I therefore believe these plates were not firmly attached in the living animal, but merely leaned against each other as well as upon the tooth-like projections, being only attached to the inner edge of the quadrangular plates by muscular or interarticular substance, and that they were, in analogy with similar plates in recent Crinoids, movable. This seems further confirmed by the construction of the plates themselves, and especially by the manner of their attachment. The inner edges of the quadrangular plates (between the projections) being slightly convex, they rested in regular sockets, which facilitated their opening in an outward direction. In case these plates, as I can no longer doubt, could be opened or closed, it seems reasonable that they were open in my specimen when the animal died; or they otherwise would have been preserved.

The position and construction of the inner channel proves most satisfactorily, and in analogy with recent Crinoids, that it contained the *food-groove* which conveyed the food through the arm-openings beneath the vault to the oral aperture. The small movable plates are evidently homologous with the "Saumplatten" of *Antedon*; and the imbrication of these plates, as well as of the entire covering, seems to hint at the conclusion that the furrow was always closed when the arms were folded up as in Mr. Springer's specimen, but that, on the contrary, as in my specimen, the furrow was open when the arms were spread, and that in this position the animal took in its food.

In describing the covering of the furrow, I have already mentioned the presence of two rows of small pores located at the angles of the triangular pieces. There is nothing to indicate that these pores were sockets of pinnulæ; if they had been the "Saumplatten" could not have opened. From their position I infer they were passages for tentacles connecting with parts of the inner tube. If this is correct, it seems to me there must have been located within the tube a passage in connexion with the ambulacral system, since the tentacles form a part of it. This is evidently the case. In a transverse section of the arm, with the help of a magnifier, I think I have detected within the tube traces of two passages—*a deep groove* occupying only the median region, and on each side of it *a small canal* underlying the pores. The condition of the specimen does not enable me to say whether the two side passages connect at the bottom or not; but in either case they undoubtedly represent *the ambulacral canal*, the food-groove occupying only the median and upper part of the channel.

It is to be regretted that in no instance the upper part of

the tubular skeleton has been found in perfect preservation. There has been observed beneath the vault an annular vessel, constructed of plates similar to those of the radiating tubes, with small openings directed toward the radial sides of the specimen, with the alimentary canal passing through the inner space of the ring; but its connexion with the surrounding parts was not preserved. The position of the annular organ in the centre of radiation leaves but little doubt that it is *the œsophageal ring* or *centre of the ambulacral system*. The great similarity in the construction of its plates, the presence of openings corresponding to the direction of the tubes, indicate most strongly that the tubes and the circular organ were connected, and that the ambulacral canal, which I recognized in the lower passage of the arms, communicated with the pores. But, as seen from the casts, there proceeded below the vault, from the arm-bases to the centre, another series of passages, which, passing the region of the annular vessel, united in the centre. I hold these to be a continuation of the food-grooves in the arms, which evidently, passing over the top of the circular organ, terminated within the central orifice.

The position of the œsophageal ring seems at first sight to be not quite in harmony with recent nature; this organ, which, in all Echinoderms with an external mouth, is attached to the inner side of the test, is located in Palæozoic Crinoids at a distance from the vault. However, considering that the aboral vault cannot be homologized with the oral skin of recent Crinoids, and that only the tubular skeleton corresponds to the radiating passages connecting with the peristome, the vault thus forming a mere covering, we shall find the position of the circular organ perfectly harmonious with that of all other Echinoderms.

I have mentioned already that there exists in the arm-groove of *Cyathocrinus*, beneath the tube and at the bottom of the furrow, another canal, as large as, or larger than the channel of the tube, whose functions are unknown. It was, apparently through the bottom of the arm-openings, connected with the perivisceral cavity of the calyx, and may have served for several offices, containing perhaps also the cœliac canal.

Dr. Schultze, in his Monograph on the Echinoderms of the Eifel, p. 17, gives a most excellent description of the arm-furrow in *Cupressocrinus*. He found two sets of plates covering the furrow like a roof, and asserts that the inner pieces could be turned back in the living animal. I had overlooked this in making out my descriptions; but it was pleasing and highly satisfactory to me to find that we both had arrived independently at the same conclusion. The construction of the arm-

furrow of *Cupressocrinus* is very similar to that of *Cyathocrinus*. In a section of the arm of this genus I readily distinguished, by transmitted light, the food-groove, which has a narrow and deep outline, a canal on both sides of it; and I have but little doubt that the arm-furrows were similarly constructed in all Palæozoic Crinoids.

3. *The Alimentary Canal.*

Meek and Worthen publish, in the 'Geological Report of Illinois,' vol. v., most excellent descriptions and figures of an organ which occupies the greater part of the visceral cavity of Palæozoic Crinoids; they call it, from its position, in analogy with other Echinoderms, "*the digestive organ.*" It is a large convoluted body, resembling in outer form and outline the shell of a *Bulla*, with a longer vertical axis, and open at both ends. The upper end is placed below the centre of the ventral disk, the lower one directed toward the column, dilated above, contracted below, coinciding with the inner space of the visceral cavity, to the walls of which it stands nearly parallel. In some cases it is subcylindrical and slightly truncate at both ends.

The organ is constructed of a great number of very minute pieces or bars with intervening meshes; but its delicate texture is but seldom observed, owing to the presence of incrustations of calcareous or siliceous matter, which fill up the meshes and give to the structure a rather dense appearance*.

The convolutions are directed outward from left to right, varying in number from two to four in different species. Judging from external appearance only, the convoluted walls of the organ appear as mere partitions leading to the inner chamber of a *Bulla*-shaped body. This, however, is not the fact. Examining the so-called walls in some transverse sections, I find them to be coiled, without touching each other at any point, and composed of two distinct partitions, placed side by side and closed at the edges, thus proving that the apparent walls are the coiled organ itself. According to this, the digestive organ consisted of a long flattened canal, rounded at the outer side, widest in the middle, tapering rapidly at both ends to a rather heavy flattened tube, the outer end ascending spirally toward the top of the visceral cavity, making two or more turns, while the inner one, winding in a spiral way around its own axis, passed upward to near the centre of the dome.

* To these incrustations, which are evidently deposits from the water, we owe, in a great measure, the preservation of these delicate organs; and as they are comparatively thicker in adult specimens, they seem to have accumulated already during the life of the Crinoids, and may have caused, in many instances, their death.

In a specimen of *Actinocrinus* in which the digestive organ is apparently perfect, though showing the usual rough appearance, I succeeded in removing at one side the two upper convolutions, in such a manner that the detached parts can be replaced or lifted up for investigation. I had here an opportunity to examine the inner or, more properly, upper end of the alimentary canal (as distinguished from the outer end or terminal part). The top is unfortunately hidden below some inorganic matter; but enough can be seen to prove that it proceeded evidently from a place below the centre of the dome. The organ, where it comes into view, is an elongated tube, which, passing downwards, widens first gradually to near the middle of the visceral cavity, then rapidly until it acquires the width of at least two thirds of the entire length of the cavity. The upper end in descending spirally turns from right to left, but on becoming wider curves sharply in the opposite direction and the convolutions are now directed from left to right. The outer end, also tapering rapidly and forming a flattened tube, ascends the outside spirally from below all the way up to the top, and, I am inclined to suppose, proceeded to the proboscis, being probably analogous to the terminal intestine of the Echini, while the upper end communicated with the food-groove.

Such, with slight modifications, was probably the construction of the alimentary canal of all *Actinocrinidæ*, *Platycrinidæ*, &c., but not that of the genus *Ollacrinus**. I found the alimentary canal partly preserved in *Ollacrinus tuberculosus*, Hall, in which it seems to have been composed of the same delicate network; but the organ consists here of a round canal which descends spirally, and, contracting gradually, takes at the lower portion of the visceral cavity an upward direction. The upper part of the organ is unfortunately not preserved in this specimen.

4. *The Anal Aperture and the Proboscis.*

The anus of Palæozoic Crinoids is placed always within one of the interradial series, which is generally wider than, and often constructed differently from, the others. The aperture is situated either in some part of the calyx itself, or at the top

* Figured by Cumberland without generic or specific diagnosis or specific name, London, 1826, in the Appendix to 'Reliquiæ Conservatæ.'

Synon.:—*Gilbertocrinus*, Phillips, 1836, Geol. Yorkshire, pt. ii. p. 207. *Goniasteroidocrinus*, Lyon & Casseday, Suppl. Geol. Rep. Iowa, p. 70. *Trematocrinus*, Hall, 1860, Suppl. Iowa Geol. Rept. p. 70.

As Cumberland's figure is perfectly correct and easily identified as *Ollacrinus* (*Gilbertocrinus*) *calcaratus*, his generic name "*Ollacrinus*" must be retained according to the laws of nomenclature.

of a long proboscis. It is a most remarkable fact that genera which evidently belong to the same group, even species apparently of the same genus (for instance, *Strotocrinus*), differ so widely in the construction of this organ—some having a long massive tube, reaching to several inches above the tips of their arms, while others are provided only with a plain lateral opening without any superstructure whatever.

I do not speak at present of the inflated or balloon-shaped proboscis of *Zeacrinus*, *Cœliacrinus*, *Poteriocrinus*, *Heterocrinus*, and similar genera, in which this part is more properly called "*the ventral sac*," as it evidently formed a large portion of the visceral cavity. Its great size compared with the lower cup, the presence of large numbers of small pores, and the position of the anal aperture near the bottom instead of at the summit, seems to imply that the anal apparatus occupied in the internal economy of this sac only a limited space. The inflated sac, accordingly, cannot be homologized with the slender, heavy-plated tube of *Actinocrinus*. We can only compare its lateral opening, which is generally placed low down near the arm-bases, with the anal aperture of species in which the anus is located in the ventral disk.

In addition to its regular functions, the proboscis of Palæozoic Crinoids may have had the office of expelling the water from the system. This suggestion looks not unreasonable, if we consider that the solid body of the majority of these Crinoids had apparently no other outlet. I found in one instance the proboscis split open longitudinally, and within its inner cavity a well-defined narrow tube, filling scarcely one fourth of the inner space. This tube may have connected with the terminal intestine which I have described above; and the office of the surrounding canal may have been to eject the deoxygenated water from the body. The fact that some Crinoids were provided with a proboscis reaching beyond the region of the arms, and others with no proboscis whatever, but simply a lateral opening, is easily explained; for if the rejected matter were emptied between the arms, it must have come constantly again into contact with the arm-currents, which is obviated by either plan. This accounts also for the fact that the proboscis of some species of *Eretmocrinus* is constantly turned to one side. The proboscis formed a natural support for the slender arms; for they are found in most specimens leaning closely against it, while in *Dorycrinus*, which has no proboscis, the arms appear always clinging to its long, heavy spines, which are evidently not weapons of defence, as some authors have supposed, but merely a support and protection for the arms.

Dr. C. A. White describes, in the 'Boston Journ. of Nat.

Hist.' vol. vii. no. 4, p. 489, several specimens in which the proboscis diverges at some distance above the ventral disk into two distinct branches. This may be, in some instances, the result of accidental development, but is more frequently due to an obstruction of the anal canal. I found a specimen of *Batocrinus longirostris* in which, close to the vault, the proboscis branches into two equally heavy tubes; and there appears immediately above their junction a strong inflation or kind of abscess. In another specimen a stoppage or disconnexion must have occurred within the body, for a second proboscis was formed at the ventral disk, developed here, as in every other instance, within the anal series or posterior side of the Crinoid. In one remarkable specimen a second proboscis breaks forth even at the lower end of the calyx, just above the basal plates. The pressure against these parts must have been enormous; for it caused the destruction of an entire ray, the plates of which are bulging out, forming, together with the anal plates, and intermingled with smaller plates such as ordinarily compose the proboscis of this species, a large elongated cavity with a rather large aperture. All these instances give evidence of a pressure from within, and indicate that the outside opening of Palæozoic Crinoids was solely an ejective organ, and could not have had oral functions. I have already mentioned that the anus is separated from the radial series by deep partitions at the inner surface of the vault, thus excluding any connexion with the upper end of the digestive organ. Moreover the casts of *Actinocrinus* show that the course of the proboscis is directed toward the posterior side; and the development of the abnormal proboscis occurs invariably in the anal series. It is therefore hardly necessary to argue on Dr. White's supposition, that the abnormal second proboscis, wherever it occurs, might have served as buccal orifice, as such a theory is unsupported by analogy.

[To be continued.]

XLV.—*Descriptions of new Species of Heterocera from Japan.*—Part III. *Geometrites**. By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

Urapteridæ.

153. *Urapteryx veneris*, n. sp.

White; primaries crossed by three brown stripes, which converge towards the inner margin; a discocellular litura of

* The Geometrites described in 'Illustrations of Lepidoptera Heterocera' are not included in this paper.

the same colour; outer border narrowly brown, intersected by an orange line; the transverse stripes of the female also orange at their inferior extremities: secondaries with a dot at the end of the cell and a litura across the internal area brown; a fulvous discal belt brownish at the extremities, subangulated and expanded in the middle; two black spots above the caudal angle; fringe orange, tipped with white. Under surface with the stripes dark brown, broken up into spots; the secondaries with two additional brown spots beyond the cell. Expanse 1 inch 5–6 lines.

Yokohama (*Jonas*).

Ennommidæ.

THIOPSYCHE, n. gen.

Allied to *Rumia*, but the palpi longer and more slender; the primaries more acuminate, the outer margin more oblique, undulated, slightly excised at external angle, the inner margin sinuous, the median branches emitted nearer together; secondaries much shorter, with sinuated outer margin, an angle below the apex, costal margin slightly irregular, costal vein running close to the subcostal for two fifths of its length; discoidal cell shorter. Type *T. Pryeri*.

154. *Thiopsyche Pryeri*, n. sp.

Shining sulphur-yellow; outer margin of wings black-brown; fringe very short, white: primaries sparsely speckled with ferruginous; base of costa ferruginous, speckled with white, with several black dots on the margin, followed by an irregular abbreviated oblique ferruginous stria; external area slightly reddish, excepting at the outer angle; two irregular white-speckled red-brown spots beyond the centre of the inner margin: secondaries with a discal series of ferruginous dots on the veins; a red-brown costal spot; collar and palpi tinted with ferruginous. Wings below paler, spotted and speckled with ferruginous rather more than above; the primaries with a broad ferruginous abbreviated band across the apical area; body whitish. Expanse 1 inch 4 lines.

Yokohama (*Jonas*).

I have named this pretty little species after Mr. Pryer of Yokohama, an energetic collector, to whom we are indebted for several interesting Japanese novelties.

ENDROPIA, Guénée.

155. *Endropia mactans*, n. sp.

Wings above bright burnt-sienna red; the disk almost

covered by a nebulous plumbaginous belt, limited internally by the outer line; two parallel oblique lines of blackish, abruptly angulated in the primaries near the costal margin; costal border of primaries spotted with saffron-yellow; a dusky patch above the end of the cell; a black dot at the end of the cell: head blackish, with white crest; thorax whity brown, with the tegulæ tawny; abdomen deep red, anus white. Under surface testaceous, clouded with grey; the markings as above, all the wings with prominent black discocellular spots. Expanse 1 inch 5 lines.

Yokohama (*Jonas*).

This species somewhat resembles the genus *Chilma* of Walker.

DESCOREBA, n. gen.

Allied to *Caberodes*, with which it agrees in neuration; it differs in having its antennæ pectinated to the tips, its thorax more woolly, and the outer margin of the primaries not angulated. Type *D. simplex*.

156. *Descoreba simplex*, n. sp.

Primaries pale stramineous speckled with dark brown scales and crossed from the apex to the inner margin by a dark brown oblique line; a blackish discocellular dot: secondaries snow-white, slightly tinted with stramineous on the outer border: body stramineous, tegulæ clothed with long whitish hairs. Under surface creamy white, speckled with brown; a discal series of black dots on the veins; primaries with fulvous costa, markings paler than above; secondaries with stramineous costa; legs varied with brown. Expanse 2 inches 1 line.

Yokohama (*Jonas*).

Aspilates niponaria of Felder is a second species of this genus.

Œnochromiidæ.

NIPHONISSA, n. gen.

Allied to *Monoctenia*, but altogether more slenderly built, the palpi longer, the antennæ considerably more slender, the tegulæ rather shorter, the primaries more sharply angulated. Type *N. arida*.

157. *Niphonissa arida*, n. sp.

♂. Primaries above pale sandy brown, speckled with grey; an oblique grey discal line; a black-edged whitish discocel-

lular dot; apical half of costal margin ochreous; fringe very short, olivaceous, tipped with white: secondaries sandy yellowish irrorated with grey; an interrupted grey discal line and a grey discocellular annulus: body sandy yellowish. Under surface sandy whitish, irrorated with grey; markings nearly as above. Expanse 2 inches 1 line.

♀. Larger and brighter in tint than the male, the discal line of primaries edged with white. Expanse 2 inches 4 lines.

Yokohama (*Jonas*).

Boarmiidæ.

BOARMIA, Treitschke.

158. *Boarmia conferenda*, n. sp.

Nearly allied to *B. consortaria*, but much darker, greyer; the discocellular spot of secondaries larger; under surface whity brown instead of creamy white, but with the same markings. Expanse 2 inches.

Yokohama (*Jonas*).

159. *Boarmia lunifera*, n. sp.

Allied to *B. roboraria*, but much darker and larger, the first two blackish lines of the primaries less arched, but rather more irregular; the third line well separated; the two central lines of secondaries nearer together; the outer border of all the wings smoky grey, bounded internally by a series of well-defined blackish-bordered lunate spots. Wings below grey, with blackish discal belt and discocellular spots; primaries with pale costa on which are two black spots, the first of two series of grey spots which cross the wings; apex of primaries white; body below grey. Expanse 2 inches 7 lines.

Yokohama (*Jonas*).

160. *Boarmia displicens*, n. sp.

Near to *B. rhomboidaria*, but altogether darker, the pale spots replaced by white; the three black lines of primaries placed in the male at about equal distances, the middle one not being confused with the outermost one; the two central lines of secondaries much wider apart. Expanse 1 inch 8 lines.

Yokohama (*Jonas*).

161. *Boarmia leucophæa*, n. sp.

Also allied to *B. rhomboidaria*, but considerably darker; the primaries with a white spot just beyond the second black line

and near the apex; the black lines strongly defined; the basal area and one or two ill-defined discal streaks whitish; the central lines of secondaries much nearer together and more strongly defined. Under surface quite different, pale grey, with discocellular spot and discal belts of slightly darker grey. Expanse 1 inch 11 lines.

Yokohama (*Jonas*).

162. *Boarmia angulifera*, n. sp.

Allied to *B. repandaria*, but little more than half the size, considerably darker, more sooty in tint, the markings of the primaries more sharply defined; fringe much longer; primaries below much darker, with a pale patch beyond the cell and a pale apical spot; discocellular spots strongly marked; black marginal spots better marked; fringe spotted with grey. Expanse 1 inch 4 lines.

Yokohama (*Jonas*).

163. *Boarmia agitata*, n. sp.

Allied to *B. repandaria*, but half as large again, the wings (particularly the primaries) far more silky; the lines grey, blurred, but the multitudinous little grey striations more distinct; primaries with a blackish abbreviated bar across the discocellulars, followed by a very irregular whitish band from costal to outer margin; a second narrower blackish bar beyond the cell, being the commencement of the outer or discal line; apex whitish; several subapical white spots; lines of secondaries nearer together, the inner one not being central. Wings below pale smoky brown, with discal lines and whitish markings as above. Expanse 2 inches 4 lines.

Yokohama (*Jonas*).

164. *Boarmia grisea*, n. sp.

Allied to *B. momaria*, black lines similar to those of *B. repandaria*; wings above ashy grey, with the basal and discal areas clouded with red-brown; margin dotted with black; primaries with a black-edged 8-shaped brown spot at the end of the cell. Under surface whitish, with grey discal belt; the lines grey, ill defined; primaries with a white apical spot. Expanse 1 inch 8 lines.

Yokohama (*Jonas*).

165. *Boarmia senex*, n. sp.

Belongs to the *B.-consortaria* group, but rather whiter and with broader primaries; the lines black and similar to those

of *B. trispinaria*, excepting that the outer line is rather nearer to the external margin and more strongly dentated. Expanse 2 inches.

Yokohama (*Jonas*); Hakodaté (*Whitely*).

166. *Boarmia insolita*, n. sp.

Wings above silvery grey; a subbasal sandy yellowish belt, on and immediately beyond which are two interrupted transverse black lines; a black costal oblique dash above the end of the cell, and a small yellow spot at base of first median branch; an interrupted sinuated black line beyond the cell, followed by a sandy-yellowish discal belt; outer border broadly dusky, intersected by a submarginal undulated whitish line; two quadrate dusky patches placed angle to angle from above the second median branch to the outer margin; a series of black marginal spots: secondaries with discal lines and belts, and marginal spots as in the primaries. Under surface silvery white, with dusky discocellular spots; primaries with the discoidal and apical areas faintly tinted with grey; an ill-defined grey discal line. Expanse 1 inch 7 lines.

Hakodaté (*Whitely*).

Allied to *B. cinctaria*.

TEPHROSIA, Boisduval.

167. *Tephrosia charon*, n. sp.

♂. Silvery grey; the wings crossed by three black lines, the two outer ones of the primaries converging towards the inner margin, and all of them bent inwards above the middle; outer border slightly darker than the rest of the wings, intersected by a wavy dusky-bordered white line; thorax transversely banded with black: under surface grey; the wings with a very slightly darker discal belt. Expanse 1 inch 11 lines.

♀. Much browner in tint; the under surface with well-defined darker discal belt, very dark on the primaries. Expanse 1 inch 9 lines.

♂, Hakodaté (*Whitely*); ♂ ♀, Yokohama (*Jonas*).

168. *Tephrosia ignobilis*, n. sp.

Nearly allied to *T. transfixaria* from East Florida, but the lines across the wings less oblique, the first one also not double; under surface sandy brown instead of whitish. Expanse 1 inch 4 lines.

Yokohama (*Jonas*).

This is a silvery grey or whitish species crossed by four irregular blackish lines, the last two of which are doubled; the outer border is dusky.

HYPOCHROMA, Guénée.

169. *Hypochroma Pryeri*, n. sp.

Allied to *H. dispensata*, but ashy grey; the two lines across the wings similar, external area crossed by a zigzag white line; black discocellular dots; a marginal series of black dots: wings below white; a broad discal blackish belt with straight internal edge, produced externally in one or two places so as to reach the margin; black discocellular spots; primaries with greyish basal area. Expanse 1 inch 8 lines.
Yokohama (*Jonas*).

170. *Hypochroma superans*, n. sp.

Testaceous, the wings, excepting at the base, greenish sericeous crossed by multitudinous short grey lines; black discocellular lines; an interrupted irregular white lunulated discal stripe, indistinct in secondaries; a submarginal series of white dots; a marginal series of black spots; fringe rather long, ashy grey; primaries with the costa black-spotted; apex of palpi and frons black. Under surface of the wings white, yellow at the base; large black discocellular patches; a blackish spot in each discoidal cell, and below it a well-defined grey longitudinal dash; a broad blackish discal belt crossed by an interrupted white line; a series of black marginal spots: primaries with the costa black-spotted; external area streaked with blackish: body ochraceous, legs above blackish. Expanse 2 inches 6 lines.
Yokohama (*Jonas*).
One of the finest species yet described.

BYLAZORA, Walker.

171. *Bylazora virescens*, n. sp.

Primaries above pale dull sericeous sap-green, irrorated with black scales, most densely towards the base; costal margin black-dotted; an oblique abbreviated line across the cell, the discocellulars and an oblique, slightly concave subapical line blackish; three or four subapical hastate blackish spots in a transverse series beyond the line; a zigzag submarginal blackish line, black-dotted externally, and connected with a series of black marginal spots by blackish longitudinal internervular lines: secondaries pale greyish brown, nearly

white; discocellulars and an irregular discal line dusky; disk beyond the line striated with dusky scales; a marginal series of black dots: body corresponding in colour with the wings. Under surface sericeous white, a series of black marginal dots: primaries with dusky-speckled testaceous costal margin; a quadrate discocellular blackish spot; a blackish angular discal stripe: secondaries with elongated discocellular blackish spot; an ill-defined discal stripe. Expanse 1 inch 9 lines.

Hakodaté (*Whitely*).

Geometridæ.

JODIS, Hübner.

172. *Jodis claripennis*, n. sp.

Aspect of *J. putataria*, but of twice the size; chalky white with a single snow-white discal line bordered internally by a pale yellowish line, oblique in primaries and subangulated in secondaries; costal margin of primaries and antennæ pale ochraceous; frons, palpi, and margin of eyes ferruginous; under surface of tibiæ and tarsi ochraceous; wings below without discal line. Expanse 1 inch 6 lines.

Yokohama (*Jonas*).

THALASSODES, Guénée.

173. *Thalassodes marina*, n. sp.

Pale bluish green; wings shining, with irregular angulated discal line; fringe white; primaries with ochreous costal margin spotted with black; crest of head and base of antennæ white, abdomen whitish; under surface paler, without markings: body below white. Expanse 1 inch 1 line.

Yokohama (*Jonas*).

THALERA, Hübner.

174. *Thalera crenulata*, n. sp.

Pale green; margin of the wings ferruginous; fringe white, spotted with ferruginous at the terminations of the nervures; primaries with creamy costal margin; two transverse, irregular, parallel, shining white lines; secondaries with one irregular white discal line; antennæ white; frons, palpi, and part of the anterior legs ferruginous, remainder of legs white; wings below paler, without white lines. Expanse 11 lines.

Yokohama (*Jonas*).

Ephyridæ.

ANISODES, Guénée.

175. *Anisodes hadassa*, n. sp.

Ochraceous, wings irrorated with grey, crossed by three more or less defined crenulate grey lines bordered with dull lilacine (in some examples barely distinguishable); well-marked black discocellular spots; a marginal series of more or less defined blackish dots; primaries with the costa more or less plumbaginous and transversely striated with grey; collar grey or plumbaginous: under surface paler and clearer; primaries always with one well-marked discal grey stripe (some examples with two in all the wings); grey irrorations and black discocellular spots as above. Expanse, ♂ 1 inch 2 lines, ♀ 1 inch 4–5 lines.

Yokohama (*Jonas*).

Allied to *A. imitaria.*

Acidaliidæ.

ASTHENA, Hübner.

176. *Asthena corculina*, n. sp.

Snowy white, sericeous; wings crossed by parallel irregular ochreous belts at equal distances, seven on the primaries (the last abbreviated), and three across the disk of secondaries; discocellular spots and marginal dots black; belts below ill-defined, grey; spots black, but less defined, the marginal dots partly or wholly absent. Expanse 9 lines.

Yokohama (*Jonas*).

177. *Asthena superior*, n. sp.

Nearly allied to the preceding, but larger, the wings sparsely and minutely black-speckled; secondaries with an additional ochreous belt across the discoidal cell: wings below snow-white, with a single grey discal line; discoidal area of primaries slightly greyish. Expanse 11 lines.

Yokohama (*Jonas*).

Although larger, this is a more delicate-looking species than the preceding.

178. *Asthena confusa*, n. sp.

Shining white, with large black discocellular spots; primaries crossed by six ochreous irregular belts at unequal distances, the three outermost crowded together; four marginal

black dots towards apex; fringe slightly ochreous: secondaries crossed by four parallel ochreous belts, the first crossing the cell, the others discal. Belts below brown, obsolete towards the base; black spots as above; primaries with brownish discoidal area. Expanse 1 inch.

Yokohama (*Jonas*).

179. *Asthena nupta*, n. sp.

♂. White, minutely black-speckled; primaries crossed by five, and secondaries by four parallel irregular yellowish belts, the outermost belt marginal and ill-defined: under surface with the belts reduced to grey lines, very indistinct on the secondaries, the one across the cell of primaries obsolete; black discocellular dots; primaries with yellowish costal margin. Expanse 1 inch 1 line.

♀. Slightly yellower than the male, larger, with better-defined markings. Expanse 1 inch 4 lines.

♂, Yokohama (*Jonas*); ♀, Hakodaté (*Whitely*).

This species is allied to the European "*Acidalia sylvestraria*" and *A. byssinata*; but as I find that *A. sylvestraria* does not differ in structure from *Asthena candidata* I shall place both in *Asthena*.

ACIDALIA, Treitschke.

180. *Acidalia hanna*, n. sp.

Pale brown, wings crossed by a central oblique dusky belt, on which the discocellular spot of secondaries is placed; three irregular brown discal lines converging towards the costa of primaries; these wings with one or two oblique basal lines; marginal and discocellular dots black, collar brown: under surface whiter, the belt and lines ill-defined; a discal series of black dots in addition to those of the upper surface. Expanse 10 lines.

Yokohama (*Jonas*).

A variety of the female occurs, nearly white, with the markings ill-defined and the wings expanding 1 inch.

A. hanna is allied to *A. inductata*.

181. *Acidalia jakima*, n. sp.

Upper surface whity brown, with rosy lilacine costal and outer borders: primaries crossed by three slightly wavy oblique rosy lines, the outermost of which bounds the lower half of the outer border; a black discocellular dot; fringe pale tawny: secondaries crossed by two wavy lines, the outer one

bounding the outer border; discocellular dot and fringe as in primaries: body whity brown; back of head and collar lilacine; anal segment slightly lilacine, with testaceous terminal tuft: under surface sericeous, with two wavy discal dark grey lines; a slender blackish marginal line; primaries greyish. Expanse 11 lines.

Yokohama (*Jonas*).

MICRÆSCHUS, n. gen.

Allied to *Hyria*, with which it has been confounded, but differing in the more robust character of its body and broader shorter primaries with angulated outer margin. Type *Hyria elataria*.

182. *Micræschus aureus*, n. sp.

Primaries golden straw-yellow, crossed by two slender blackish lines, the inner one concave, the outer one angulated, between them a black discocellular dot; margin black; fringe white, spotted with black at apex and below the middle: secondaries white, with brownish external area; marginal line black, fringe sordid white: body straw-colour. Under surface white, primaries clouded with greyish brown; discocellulars and an angulated discal stripe black; costal margin black-spotted towards apex; fringe as above: secondaries with black discocellular dot and blackish discal spot. Expanse 8 lines.

Yokohama (*Jonas*).

Microniidæ.

EROSIA, Guénée.

183. *Erosia moza*, n. sp.

Shining greyish brown, reticulated with slaty grey; fringe dark brown: primaries crossed near the base by an arched dark brown line; an oblique abbreviated dark brown line from the costa beyond the middle; a dark brown quadrate spot bounded externally by a black Γ-shaped marking on the inner margin, and a reddish-brown streak spotted with black near the outer margin: secondaries crossed near the base by a black line; a black angulated and sinuated discal line, edged externally with white, and partly bounded internally by a tawny belt; a sordid ochraceous sagittate marking through the cell; a sordid ochraceous streak from the inferior caudal process to just beyond the end of the cell; a black costal litura near apex; two white-edged black dots above the in-

ferior caudal process; marginal line silvery white, edged internally with brown. Under surface whity brown, striated with blackish; primaries suffused with grey. Expanse 1 inch.

Yokohama (*Jonas*).

Some examples are rather smaller and much paler than the type.

184. *Erosia rapha*, n. sp.

Snow-white; wings crossed near the base by a semicircular series of dark brown dots: primaries with a very irregular red-brown discal band, margined and intersected by blackish lines and bounded externally by subconfluent large black spots; two subapical black dots connected with the apex by a black line; a sigmoidal pale-brown marking near the outer margin; base of costa blackish: secondaries with the external area excepting at apex broadly red-brown, interrupted by one or two small white spots, and internally by an angulated white-edged brown discal line; margin from the superior caudal process downwards dark brown; a black dot below the inferior process: body spotted with blackish. Under surface white; basal area sordid; external area, especially of primaries, varied with smoky brown. Expanse 11 lines.

Hakodaté (*Whitely*).

185. *Erosia azela*, n. sp.

Primaries above with the basal two thirds, excepting a creamy patch at centre of inner margin, chocolate-brown, crossed by two parallel tawny transverse lines; external area silvery white, brown-speckled internally, and interrupted by a marginal series of triangular brown spots: secondaries with the basal half cream-coloured, bounded by a brown discal belt; external area silvery white; marginal spots as in primaries, but smaller; fringe spotted with brown: head and thorax blackish; shoulders plumbaginous; abdomen cream-coloured. Under surface altogether paler, but very similar in character to the upper surface. Expanse 11 lines.

Yokohama (*Jonas*).

Caberidæ.

Cabera, Treitschke.

186. *Cabera eliela*, n. sp.

Whity brown: primaries crossed by nine irregular white stripes, the fifth and sixth of which are convergent in the centre, and form the central band, the ninth submarginal and

zigzag: secondaries crossed by five or six stripes, somewhat confused at the base, the outermost one being submarginal and zigzag; a scarcely perceptible slender blackish marginal line bordered with white; fringe whitish. Under surface greyish; the lines, excepting two across the disk, confused and indistinct. Expanse 1 inch 6 lines.

Yokohama (*Jonas*).

Somewhat allied to *C. unduliferaria* of Motschoulsky.

CORYCIA, Duponchel.

187. *Corycia virgo*, n. sp.

Silvery white; wings with blackish dots at the terminations of the veins; a brown dot at the inferior angle of each discoidal cell; antennæ bright ochreous. Under surface pearly; legs slightly yellowish. Expanse 1 inch 5 lines.

Yokohama (*Jonas*).

188. *Corycia sacra*, n. sp.

Snow-white, each wing with two well-defined black discocellular spots: primaries crossed by two pale ochraceous stripes, the inner one angulated, the outer one zigzag; secondaries crossed by one slightly undulated discal stripe: wings below without stripes. Body creamy; antennæ with ochraceous pectinations. Expanse, ♂ 1 inch 2 lines, ♀ 1 inch 4 lines.

Yokohama (*Jonas*).

THYSANOCHILUS, n. gen.

Allied to *Corycia*, but the antennæ broadly pectinate for three fourths of their length, and then naked to the tip; wings with long internal and external fringes. Type *T. purus*.

189. *Thysanochilus purus*, n. sp.

Shining white; wings speckled with dark brown, with black discocellular dots: primaries crossed by three ochreous stripes, the innermost and outermost being regularly zigzag, the central stripe less strongly zigzag; fringe of internal border ochreous: secondaries crossed by two zigzag ochreous stripes: antennæ with grey pectinations. Wings below with the brown speckling more distinct, only the discal stripe discernible. Expanse 1 inch 4 lines.

Yokohama (*Jonas*).

Macariidæ.

Macaria, Curtis.

190. *Macaria zachera*, n. sp.

Sordid white, becoming pure white at outer border, speckled with black; two central parallel dark brown lines on a yellowish ground, the outer one abruptly angulated and forked towards the costa of primaries, the fork filled in with ochraceous; a slender undulated marginal blackish line; fringe cream-coloured; black discocellular spots: primaries crossed by an angulated dark brown line near the base. Body greyish. Wings below brighter than above, but very similar in marking. Expanse 1 inch 5 lines.

Yokohama (*Jonas*).

Near to *M. pervolgata.*

191. *Macaria maligna*, n. sp.

Pattern of the preceding species, but the ground-colour above slaty grey: below sandy yellow, with broad tawny external area; markings as above. Expanse 1 inch 3 lines.

Yokohama (*Jonas*).

Allied to *M. vasudeva.*

Bithia, Walker.

192. *Bithia amasa*, n. sp.

Greyish testaceous, covered with brown striations; the basal area crossed by two ill-defined subangulated darker stripes; a series of blackish discal dots more or less connected by a very indistinct undulated line, barely perceptible on the primaries; a discal pinky-brownish irregular belt, clouded with blackish in the primaries; outer border paler brown; fringe yellowish: primaries with yellow-dotted black costal margin, a pale testaceous apical patch, a series of blackish marginal spots: secondaries with whitish costal area; a blackish spot near the base; discocellulars blackish. Under surface bright testaceous, covered with brown striations; large black discocellular spots; a nearly central ferruginous stripe; a broad discal ferruginous belt; outer border clay-coloured, clouded with ferruginous: primaries with bright testaceous apical spot: anterior coxæ bright ochreous. Expanse 1 inch 8 lines.

Yokohama (*Jonas*).

Allied to "*Hemerophila*" *prætereuns.*

Fidoniidæ.

Lozogramma, Stephens.

193. *Lozogramma bela*, n. sp.

Primaries pale pinky brown, crossed immediately beyond the cell by a chocolate-brown line; secondaries whitish, with creamy external area, brown-speckled, crossed by a slender brown discal line; body cream-coloured; antennæ with blackish pectinations. Under surface cream-coloured, with yellowish costal borders; all the wings brown-speckled, with red-brown discocellular spots and grey-brown discal line. Expanse 1 inch 5 lines.

Yokohama (*Jonas*).

194. *Lozogramma Amelia*, n. sp.

Shining: primaries golden brown, crossed by three pale-edged indistinct undulated grey lines, the outermost one bounded externally by small ovoid plumbaginous spots, which become whitish towards the costa; a large rounded whitish spot enclosing a black dot, and margined with brown, at the end of the cell; external area slightly greyish, crossed by a zigzag dusky submarginal line bounded outwardly by a series of pale spots; marginal line of the ground-colour with two blackish dots on each internervular division; fringe traversed by a grey line: secondaries white, with sordid white fringe. Body testaceous. Under surface whity brown: primaries slightly greyish; upper discocellular and a subangulated undulated discal line grey; an oblique apical grey dash; marginal dots as above: secondaries with blackish discocellular dot and two subangulated discal series, the inner series very indistinctly connected by a pale line; marginal dots as in primaries. Expanse 1 inch 3 lines.

Yokohama (*Jonas*).

Selidosema, Hübner.

195. *Selidosema sordida*, n. sp.

Sordid white: primaries with pale smoky-brown borders; three greyish brown costal spots, the third slender and transverse; outer border irregularly bisinuated internally, with a greyish patch just above the middle, and a second at external angle; a marginal series of black spots: secondaries with the basal area greyish; a broad central dark grey angulated belt, bounded externally by a series of black spots; a black

discocellular spot on the belt; several greyish-brown costal spots, and an imperfect series along the outer margin; a discal spot beyond the cell and a streak near the anal angle tawny. Body pale brown; pectinations of antennæ blackish. Under surface whity brown: wings mottled with grey, with blackish discocellular dots; primaries with a central costal spot and discal arched streak grey. Expanse 1 inch 3 lines.

Hakodaté (*Whitely*).

The type of this species is somewhat rubbed; it is possible that in fresh examples there may be a brownish belt across the primaries.

[To be continued.]

XLVI.—*On the Number of Cervical Vertebræ in* Dinornis. By F. W. Hutton, Professor of Zoology in the University of Otago.

The number of cervical vertebræ in *Dinornis* was estimated in 1856, by Prof. Owen, at 15, in *D. elephantopus* (Trans. Zool. Soc. iv. p. 161); and this number was also adopted by Prof. von Haast in his printed schedule of Moa-bones in the Canterbury Museum. In Prof. Owen's paper in Trans. Zool. Soc. vol. x. p. 147, which, much to the regret of all New-Zealand naturalists, he announces as probably his last on the Moa, he still adheres to the same number, and suggests that in the photographed skeleton of *D. elephantopus* (more properly I now think *D. crassus*) in the Otago Museum there are two cervical vertebræ too many*. However, specimens in the museum of the necks of individual birds show that the real number is 20 or 21; and I therefore think it necessary for me to give the evidence for my restoration of the skeleton referred to.

The museum possesses nine necks, or portions of necks, from the sand-hills at Shag Point, Otago, belonging to single birds. These were all found in their proper positions, and were at once strung, and then numbered so as to prevent the possibility of any subsequent misplacement. The species to which they belong cannot yet be accurately determined; but they are of three different sizes. The smallest (**A**, **B**, and **G**) belong, I believe, to *D. casuarinus*; the middle size (**C**, **D**,

* Prof. Owen has been led into a mistake by having a photograph only to examine. In the skeleton, as restored, there are twenty-one, not seventeen, cervical vertebræ.

and **E**) to *D. gravis*; and the largest (**F**, **H**, and **I**) belong, I feel pretty sure, to *D. crassus*.

I follow Prof. Owen in regarding the first dorsal vertebra as that "which first retains its pleurapophyses as independent movable elements."

A. Five vertebræ, commencing with the first. The fifth has a slight median hypapophysis on the centrum. In the fourth it is strong.

B. Ten vertebræ, commencing with the first. The sixth has a very slight preaxial median hypapophysis. In the fifth it is well marked; in the seventh it is absent.

C. Eleven vertebræ, commencing with the second. The fifth (no. 4 of the series) has a median hypapophysis; there is none on the sixth.

D. Seventeen vertebræ, commencing with the first. The fifth has a median hypapophysis, the sixth none. All are cervical vertebræ; and in all both the neural spine and the hypapophyses (catapophyses of Mivart) are double. The hypapophyses are furthest apart in the fifteenth.

E. Seventeen vertebræ, commencing with the first. The fifth has a large median hypapophysis; on the sixth it is rudimentary, and absent on the seventh. All are cervical; and in all both the neural spine and the hypapophyses are double. The hypapophyses are furthest apart on the sixteenth.

F. Nineteen vertebræ, commencing with the first. The fifth has a slight median hypapophysis; there is none on the sixth. All are cervical. The neural spine is double in all. The hypapophyses are double in all, but they are nearly confluent in the last. The hypapophyses are furthest apart in the sixteenth.

G. Nineteen vertebræ, commencing with the first. The fifth has a slight median hypapophysis; there is none on the sixth. All the vertebræ are cervical. The neural spine is double in all. The hypapophyses of the last four vertebræ are destroyed.

H. Twenty-two vertebræ, commencing with the first. The fifth has a well-marked median hypapophysis; there is none on the sixth. The cervical vertebræ are twenty-one in number. The neural spine becomes single on the twentieth; and the hypapophyses become single on the nineteenth, but they are almost single on the eighteenth.

I. Twenty-three vertebræ, commencing with the fifth. A slight median hypapophysis on the fifth (first of the

series); none on the sixth. The first sixteen vertebræ of the series are cervical; and if the four missing vertebræ be added, it makes twenty cervical vertebræ altogether. The last seven are dorsal. The neural spine becomes single on the nineteenth. The hypapophyses become single on the eighteenth; and they are furthest apart on the fourteenth. I have taken the first of this series as the fifth; but, judging, from **B** and **E**, it may possibly be the sixth, in which case the rest of the neck-vertebræ would agree with **H**. This specimen has also the pelvis and the caudal vertebræ, of which latter there are ten, the last two being ankylosed. The second caudal vertebra agrees with the one figured by Prof. Owen as either the first or the second.

From a comparison of these necks with the drawings and descriptions of Prof. Owen in his last paper I infer that the vertebra figured by him as the third is really the fourth, that figured as the fourth is the sixth, that as the sixth is the eighth, that as the twelfth is the fifteenth, that as the fourteenth is the seventeenth or eighteenth, and that as the fifteenth is the twentieth or twenty-first.

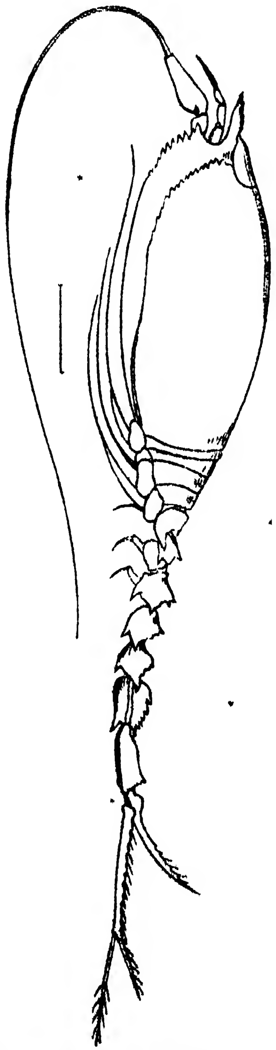
XLVII.—*Two new Crustacea from the Coast of Aberdeen.* By C. Spence Bate, F.R.S.

Two small Crustacea were sent to me some short time since by Mr. Sims, of Aberdeen, as having been taken by him on that coast during last summer. One belongs to the Diastylidæ, the other to Amphipoda. After carefully noting all the specimens with which I am acquainted, as well as consulting the works of Sars and other naturalists, I am induced to believe that neither of them has been described. I propose therefore to name them respectively *Diastylis bimarginatus* and *Lestrigonus spinidorsalis.*

Diastylis bimarginatus has the carapace very long and oval. The infero-lateral margin is anteriorly serrated beneath the antennal notch. A second ridge within the lateral margin repeats it, commencing at the base of the rostral process, where it is serrated, and continuing until near the posterior extremity of the carapace, where it becomes confluent with the infero-lateral margin. The rostral projections of the carapace are serrated on the upper margin. Five somites of the pereion are exposed behind the carapace, each becoming longer, narrower, and less deep as

they succeed each other posteriorly, and the last having the coxal plate fused with it and produced posteriorly to a strong point. The somites of the pleon are dorsally crowned with small tooth-like points, which become less conspicuous in succession posteriorly. The posterior and post-inferior angles of each somite are produced to sharp spine-like points. The fifth somite is longer than the four preceding, and the dorsal surface is serrated in the median line; the sides are flanked by a strong ridge; and the inferior margin is entire, but produced posteriorly to a sharp point. The sixth somite is cylindrical, and not produced posteriorly beyond the point where it articulates with the telson. The telson is sharp, styliform, and moderately long, being nearly as long as the two preceding somites. The styliform uropoda have the first joint half as long again as the telson, and supporting two branches, of which the inner is as long again as the outer and slightly fringed with hairs.

Fig. 1.



Diastylis bimarginatus, n. sp.

The first pair of antennæ are about as long again as the rostral processes of the carapace. The second antennæ in the male animal are nearly as long as the animal. The first joint of the peduncle is not conspicuous; the second does not reach as far as the extremity of the rostral processes; and the third reaches as far as the extremity of the first pair of antennæ; it is broad at the base and gradually tapers to the distal extremity.

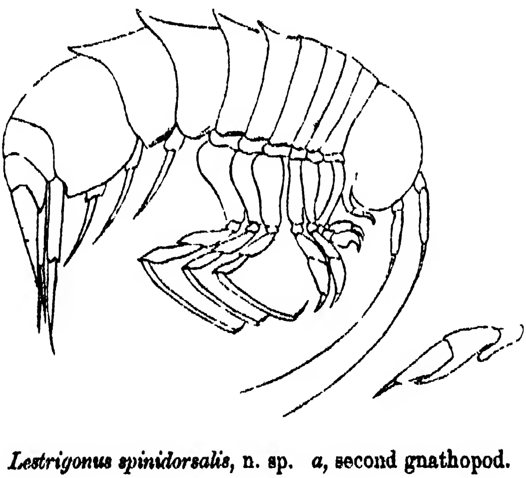
Most of the other appendages are so damaged that it is difficult to determine any specific characters in them, except the caudal pair, which have the terminal

rami unequal, the longer being about half the length of the basal joint.

Length ½ inch.

Lestrigonus spinidorsalis differs from any species of the genus that I have met with in having the last two somites of the pereion and the first three of the pleon produced in the median line of the dorsal surface posteriorly to a sharp-pointed tooth or spine. It bears in all other respects some considerable resemblance to *Lestrigonus exulans*; and I was much inclined to think that the dorsal feature might have been the result of some more

Fig. 2.



Lestrigonus spinidorsalis, n. sp. *a*, second gnathopod.

or less permanent injury; but close inspection, frequently repeated, has compelled me to believe that the spinous dorsal formation is characteristic of the animal, and one by which it may be readily distinguished from all other species.

The eyes are large, the antennæ subequally long and slender, about one half the length of the animal. The gnathopoda are short but not feeble; the first two pairs of pereiopoda are strong and robust; and the three posterior pairs are long and slender, having the propodos long with the anterior and posterior margins parallel.

Length ⅜ inch.

XLVIII.—*On Calcareous Hexactinellid Structure in the Devonian Limestone; large Fossil Hydrozoic Coralla from the Chalk; and further Observations on the Replacement of Silex by Calcite.* By H. J. Carter, F.R.S. &c.

On the shores of Teignmouth and Dawlish, in Devonshire, just after the New Red Sandstone touches the Devonian Limestone of Torbay, the former contains a number of fragments from the latter, which, as the Red-Sandstone cliff yields to the approach of the sea, fall down upon the beach, and, becoming rounded by the action of the waves and sand, are at length picked up by the lapidaries, who, selecting those which present the prettiest structure, cut and polish them for sale.

It was one of these which Mr. Sollas obtained at Dawlish, that he presented to me, I think, in the summer of 1875, and to which I have alluded as presenting a structure which, "*like* all the rest of the *Stromatoporæ*, requires to be studied in all its bearings before a correct opinion can be obtained of its original nature" ('Annals,' 1877, vol. xix. pp. 72, 73); but since the possibility of silex being replaced by calcite during fossilization has been established, and I have, through the great kindness of Prof. Zittel, received many specimens of several fossil Hexactinellid sponges, and have become better acquainted with the structure of *Stromatopora*, I have come to the conclusion that the polished pebble presents a hexactinellid structure, which, if not a sponge, was still not a *Stromatopora*.

Mr. Sollas kindly gave me polished horizontal as well as vertical sections of the structure; and on looking out among Prof. Zittel's specimens for that which is most like it, I find that, to all appearance, it is identical with *Verrucocœlia gregaria* (Quenst. et Zittel; *Verrucocœlia*, Etallon) ('Annals,' 1877, vol. xx. p. 503). The specimen is two inches in diameter, and appears to have been cut from a circular pebble about an inch in thickness.

Having, however, lately visited my friend Mr. Vicary at Exeter, whose collection of sections of *Stromatopora* (which were obtained by a gentleman from the locality mentioned, during a residence of twenty-five years in the neighbourhood of Teignmouth) consists of between three and four hundred specimens, I found two among them possessing this hexactinellid structure, but slightly modified; that is, the vertical lines in the vertical section are larger and more evidently hollow, but with no *tabulæ* or transverse septa, while here and there, on the horizontal section, are intervals tending to a stellate arrangement resembling the like in *Stromatopora*.

Still here the resemblance ends; for the cœnosarcal skeleton

is hexactinellid, not formed of a convoluted fibre like that of *Stromatopora*, and there is but one kind of pore on the surface, viz. that of the vertical lines, not two sizes as in *Stromatopora*, while the tubular lines are without *tabulæ* as just noticed; at least this is the type to which I allude.

Here it might be mentioned that there are two distinct features in *Stromatopora* which distinguish it from sponges: viz., 1st, the vertical tubes in *Stromatopora*, being for the full-grown polyps, are of the same size throughout, while all the tubes of a sponge, being parts of the excretory canal system, continue increasing in size from a mere point to their termination in the oscule or vent; and, 2nd, the vertical tubes in *Stromatopora* are interrupted by *tabulæ* or transverse septa, which do not exist in the excretory canals of the sponge. Thus, as I have before stated, *Stromatopora* more nearly resembles *Tubipora musica*, but most of all *Millepora alcicornis*; while the hexactinellid structure to which I have above alluded is more like that of the fossil hexactinellid sponges—to wit, *Verrucocœlia gregaria*, Zitt.

Doubtless in the Devonian Limestone (which may be said to be one mass of corals, of course including the *Stromatoporæ*, particularly near Newton-Abbot, where Mr. Vicary tells me there is a quarry in which not a fragment as large as a man's fist can be found without containing one or more species distinctly and beautifully differentiated, and therefore originally was probably a coral reef) there were also sponges possessing the hexactinellid structure above mentioned, unless the latter belonged to something else; but, be this as it may, thin slices alone will not decide the question, which can only be determined by the possession of a whole form for dissection. Doubtless, too, there are gradationary forms which link the Actinozoa to the Hydrozoa; and these may be accompanied by their respective coralla; so that it must not always be laid down that because the corallum is like that of an Actinozoon it must necessarily have been one, or *vice versâ*. To prove that this hexactinellid structure was a sponge it would be necessary to show that it possessed spicules, or at least an excretory canal-system like that of sponges, which can only be done by sectioning an entire specimen, such as Mr. Vicary kindly gave me of *Stromatopora* for comparison with *Millepora alcicornis*.

Pursuing the subject of extinct Hydrozoa still further, I find among Dr. Bowerbank's collections several kinds of fossils labelled "Flamborough-Chalk Sponges," chiefly composed of chalcedony with a little chalk here and there, viz.:—No. 1. Subglobular, about the size and shape of a walnut, 1 inch in

diameter. No. 2. Pyriform, stipitate, smooth, with circular concentric lines of growth, slightly compressed, 3 inches long; free or large end convex, 3 × 2 inches in diameter, with a funnel-shaped excavation in the centre ½ inch wide; the stem broken off 3 inches from the summit, and 7-8ths × 6-8ths of an inch in its diameters at the fracture. No. 3. Much the same, but extended into a cylindrical form 1 foot long, and the stem broken off as in no. 2. No. 4. Much the same, but the cylindrical portion deeply and irregularly constricted at varying intervals, so as to present a dozen segments; ending above in being divided into a few thick conical processes, but too imperfect to state how many, or whether there was any excavation in the centre as in nos. 2 and 3; covered throughout with cup-like raised cells 1-24th inch in diameter, and about 1-8th inch apart, more or less; uppermost segment 4 × 2 inches; deepest constriction, which is just where the pyriform passes into the segmented cylindrical one, 2½ inches in diameter; total length to the end of the stem, which is broken off, 15 inches, diameter of fractured end of stem 1 inch. No. 5. Agaricoid or tabular; head or tabular part presenting concentric lines of growth on both sides, with holes 1-24th inch in diameter, in juxtaposition on the upper surface, like *Favosites*; below, crooked lines of elongated cells radiating from the stem to the circumference, where they become more or less vertical to form the margin of the head; tabular portion 4½ inches in horizontal and 4-8ths inch in vertical diameter; stem round, expanding into the head, ½ inch in diameter at the fracture. No. 6. Vasiform complete or incomplete, 4 inches across the brim; wall ½ inch thick; prolonged conical apertures 1-8th inch in diameter at the base, and 1-24th inch at the aperture, sparsely scattered over the inner surface, about ¼ inch apart, more or less, the same on the outer side, but smaller in every way and more closely approximated than those on the upper surface; margin round and without cells; stem broken off, about ¼ inch in diameter at the fracture. There are several specimens of nos. 5 and 6, all of which differ considerably in their general measurements; that is, some are much larger than others.

Now I am not going into the description of these fossils further than I have done, as this would entail more time than I can afford to spare from the study of the Spongida; but I cannot help thus briefly noticing their characters respectively, in order to introduce their nature under a more interesting and satisfactory form, I think, than appears to me to have yet been accorded to them.

Of their belonging to the genus *Scyphia*, Schweigger, = *Spongites*, Goldfuss, I think there can be no doubt; and I have at least identified no. 3 with fig. 12, *a*, *b*, tab. iii. in

Goldfuss's 'Petrefacta.' De Blainville rightly describes their structure as being composed of "un tissu entièrement réticulé" (Man. d'Actinol. 1834, p. 537); and D'Orbigny, "que leur tissu a toujours été calcaire et pierreux" (Cours de Géol. 1849, vol. i. p. 208): two higher authorities it would be difficult to find.

In both these characters I agree; but we must go a little further and endeavour to find out what the nature of the *organism* was that really built them.

We may notice, then, that in all the structure is laminar, and the base a convoluted fibre like that of *Parkeria*, which, when magnified, would, on the unbroken surface, represent the convolutions of a brain. This was the cœnenchymal skeleton, while in the midst of its labyrinthic structure was an equally tortuous canal-work which held the cœnenchyma itself, and which, again, communicated with the exterior through the sulcate lines between the convolutions. Thus the sulcate lines in their turn became part of the labyrinthic tubulation as the organism added layers to the surface of its corallum, just as in *Millepora alcicornis*. Mr. Chas. Moore's specimen, to which I have alluded ('Annals,' 1878, vol. i. p. 310), shows this most satisfactorily; for, like an uninfiltrated *Parkeria*, the tubulation is all *empty*.

So far nos. 1–3 inclusive resembled *Parkeria*. But this structure in no. 4 was accompanied by straight tubes radiating from the centre at the commencement, increased in number with the increasing growth and extended circumference of the cylindrical corallum, terminating on the surface in the little holes or calicles above mentioned, among which the shallowest, of course, belong to the last layer, while the deepest belong to the first; these tubes are about 1-48th of an inch in diameter, and do not appear to have had any *tabulæ*. Much the same structure appears to have existed with the calicles in the agaricoid and vasiform varieties; only, of course, the distance from the surface to the centre in the latter is far less than that of the cylindrical form last mentioned.

Further, we observe that the cœnenchymal skeleton presents a layer of finer structure of the same kind on the surface, similar to that of *Millepora alcicornis* (just as the circumference of a tree &c. presents a finer structure on the growing surface than further in towards the stock); while just below this runs the "deep horizontal canal-system" of Moseley, to which I have alluded ('Annals,' 1878, vol. i. p. 305), which in some specimens of nos. 2 and 3, where it has been half rubbed off, shows the walls of the canal and its interior, now chalcedonized, as I have described it on the surface of *Millepora Woodwardii* ('Annals,' 1877, vol. xix. p. 65), while here

and there, passing obliquely through this fine layer, may be seen Moseley's *superficial* branches of this system.

I omitted to state in my last paper that although this system is only seen here and there on the surface of *Millepora alcicornis*, it comes into view directly the surface is slightly taken off with a very sharp knife; but it should be remembered that it is so thin that, as in *Stromatopora*, the least abstraction of the surface may bring it into view or remove it altogether, as the case may be.

Returning to the *surface* of these fossils, we find no. 1 possessing a hole laterally about 1-8th of an inch in diameter, narrowing inwards to near the centre, and issuing from it a number of grooves which spread over half the surface in a branched venation; while the other part, which is more or less dimpled like *Parkeria*, presents, every here and there, a stellate arrangement of such grooves issuing from the dimple.

Following this up we seem to find its homologue in the excavation at the ends of nos. 2 and 3, from which also proceeds the same kind of branched sinuous venation. Of the nature and function of the soft parts which occupied the hole and its grooved venation I cannot offer an opinion, further than that it might have been of the same nature and for the same purpose as that of the "horizontal canal-system," viz. for the formation of additional layers upon the test or corallum. The question may also be suggested here, whether the hole seen in many, perhaps most, specimens of *Millepora globularis* is not of the same kind ('Annals,' 1878, vol. i. p. 307).

Lastly, I must state here again that, as there are so many forms of the fossils figured by Goldfuss &c. under one head that belong to totally different organisms, many, indeed, to real sponges, as shown by Prof. Zittel ('Annals,' *l. c.*), it is very desirable, as I have before stated, that they should be all "relegated to their proper position in the animal kingdom" by the palæontologist. All I can do is to point out, as Prof. Zittel has done for sponges, the structure of those which have accidentally come before me that may be termed Hydractinian or Hydrozoic.

One cannot help seeing here, too, that while the Hydrozoa (as *Stromatopora*) played such a great part in the formation of the Devonian-Limestone reef, they were also very plentiful under other forms during the Cretaceous period, and that (in *Millepora alcicornis* &c) they are doing the same kind of work in the formation of coral reefs at the present day.

With reference to the replacement of silex by calcite I have just been examining a large fossil sponge from the Chalk more or less chalcedonized (in size 7 × 5 × 2½ inches, shaped like

the "cap of liberty," compressed, conical, a little bent upon itself and formerly hollow, as indicated by a round plug of chalk, 1½ inch in diameter, in the centre of the large or free end, the smaller one having been the point of attachment; surface regularly cancellated, with interstices 1-24th inch in diameter), and find that by subjecting a portion to the dissolving influence of dilute nitric acid, a lithistid structure is brought out, in which part is chalcedonic and part calcareous, the latter in many instances having disappeared, while the former as often remains as a fragment of the original trifid lithistid spicule—just as in Prof. Zittel's case ('Annals,' 1877, vol. xx. p. 264). Here, then, it is perfectly evident that the originally siliceous spicule of the lithistid has, to a certain extent, been replaced by calcareous material.

At the conclusion of my description of Mr. Thomson's fossil sponges from the Carboniferous Limestone of S.W. Scotland ('Annals,' 1878, vol. i. p. 141) it is stated that, not only the chalcedonized spicules of *Hyalonema Smithii* present rhombohedral excavations, but the casts of turreted shells which are composed of chalcedony present the same phenomenon; and it might be added that, on the fretted-out surface of a large block of *Stromatopora* from the Devonian Limestone, I have just found casts of turreted and bivalve shells composed of calcite, which also present this rhombohedral excavation.

Here, then, we have three states, viz.:—1, the original siliceous sponge-spicule chalcedonized; 2, the casts of shells in chalcedony; and 3, the casts of shells in calcite, all presenting the same kind of rhombohedral excavations; and striking as it appears that the chalcedony and the calcite should respectively present the same kind of rhombohedral excavation, we are impelled to the conclusion, on the one hand, that the chalcedony is encroached upon by the calcite; while, on the other hand, the calcite, as a matter of course, weathers out in the form of its natural crystallization. I omitted to mention, in connexion with the former, that the fossilized spicules of *Hyalonema Smithii* do not present any of this double composition in the undecomposed Carboniferous Limestone, where they are quite smooth until subjected to the dissolving influence of an acid, when they acquire the same kind of rhombohedral excavation on the surface that is seen in the spicules of *Hyalonema Smithii* &c. when found loose in the "rotten" or disintegrated rock.

Lately Mr. Charles Moore, F.G.S., sent me some specimens of fossil sponge-spicules from the Liassic rocks of Brocastle, found also abundantly on the weathered surfaces of the Liassic rocks on both sides of the Bristol Channel, as a sample of

what have been supposed to be the remains of Calcispongiæ, from their triradiate appearance and calcareous composition (*Grantia antiqua*, Moore, Quart. Journ. Geol. Soc., Dec. 1867, p. 538, pl. xvi. figs. 33, 34). They are white, and all fragments of quadriradiate forms—that is, spicules composed of a trifid head and shaft, to me very much like the quadriradiates of *Pachastrella abyssi*, Sdt.; but be this as it may, among them was a head and part of the shaft of a trifurcate spicule which must have belonged to a siliceous sponge (*Geodia* or *Stelletta*), in the same condition of fossilization as the rest—that is, calcareous. I took a fragment of one from the parent rock, and having placed it in a little dilute nitric acid, saw it effervesce, and at last break down into minute particles; while Mr. Moore informs me that he treated some with hydrochloric acid, and they all disappeared.

Now it is very natural that trifid forms of sponge-spicule should be taken for those belonging to the Calcispongiæ, especially if they are calcareous; but it should be remembered that while there are very few Calcispongiæ which possess triradiates or quadriradiates sufficiently large to pass through the ordeal of fossilization without disappearing altogether, there are many Pachastrellida which possess both forms much larger than the largest of any that are known to exist in the Calcispongiæ; while the possibility of the siliceous spicule becoming calcareous during fossilization has, as above stated, been established.

Thus we may find separate sponge-spicules of the siliceous sponges and whole siliceous sponges themselves calcified; but it would not be right to call these "Calcispongiæ:" even "Calcificatæ" would be better than this.

With reference to the chalcedonized Pachastrellida and their spicules in the Chalk, I have now two beautiful specimens that appear to have been freed from the latter by an acid, each of which is from 3 to 4 inches in its longest diameter, one irregularly lobate, and the other vase-shaped, where the quadriradiate spicules, simple and trifid at the ends of their arms respectively, are identical with those of *Pachastrella abyssi*, Sdt., while they are so confusedly thrown together, and the mass thus rendered so characteristically asperous, that it is impossible to see in them any thing but a *Pachastrella*. Here too, in many parts, the trifid heads are alone visible, which might be easily taken for those of a Calcisponge—especially as *Pachastrella*, like the Calcisponge, being without that fibrous structure which entails regularity in the distribution of its spicules, appears to be entirely without arrangement of the latter; so that in this respect each looks like a bag of pins.

Thus we have undoubted evidence of the existence of *Pachastrella* in the Cretaceous period, but none such of a Calcisponge.

MISCELLANEOUS.

On the Young Stages of some Osseous Fishes: Development of the Tail. By Mr. Al. Agassiz.

In this valuable memoir the author refers to observations made in great detail principally upon *Pleuronectes*. The conclusions at which he arrives are of great interest in connexion with the succession of forms among fossil fishes.

The young *Pleuronectes*, on escaping from the egg, has the posterior extremity of its dorsal chord straight, and its caudal fin is rounded. Soon the extremity of the dorsal chord becomes greatly arched upwards, presenting a concavity towards the ventral surface; at this moment appears the first trace of separation between the embryonic caudal fin and the permanent caudal, as also the first indications of the principal and accessory rays of the tail. In the succeeding period the emargination which exists between the embryonic and the permanent caudal has become deeper and the chord is more arched, the rays are well marked, and the permanent caudal extends backward beyond the embryonic caudal.

In the further course of development the embryonic caudal acquires the form of a large independent lobe; the permanent fin extends entirely beneath it, and forms a distinct fin having the appearance of a second anal. On arriving at this point the caudal region of a young *Pleuronectes* presents a striking resemblance to that of the young *Lepidosteus* as described and figured by Wilder *.

The arch formed by the caudal extremity of the chord becomes still more strongly marked; and the permanent caudal extends at first as far as the embryonic caudal, and afterwards passes beyond it. The embryonic caudal is thrown more and more upwards; and the rays of the permanent caudal acquire a fan-like arrangement.

While these latter changes are taking place we observe a disappearance of the notochord, which precedes the formation of the urostyle. The embryonic caudal also disappears more and more, and finally only presents the form of a slight semitransparent thickening of the dorsal line. On the other hand, the permanent caudal increases continually; from being pointed it becomes rounded, and acquires the form seen in the adult. At the same time the ossification of the vertebræ takes place, the cartilages which support the rays appear, &c.

Mr. A. Agassiz has observed these same phases of development of the caudal fin in a great number of other genera of fishes belonging

* "Notes on the American Ganoids," Proc. Amer. Assoc. Adv. Sci. 1876 (Detroit Meeting).

to several families. In all the tail passes gradually from the condition of a ventral appendage situated beneath the dorsal column, to that of a terminal tail placed in continuation of the line of the vertebræ. The distinction between the two fins always occurs, but in a more or less distinct manner.

The following are the consequences which the author draws from his observations:—

Huxley and Van Beneden have opposed the theory of Agassiz and Vogt as to the parallelism existing between the embryonic tails of the existing osseous fishes and those of the fishes which appeared before the Jurassic epoch. Huxley appeals to the fact that the osseous fishes of the present day have tails the structure of which is really heterocercal. Van Beneden points out that in the Plagiostomi the tail commences by being homocercal before becoming heterocercal, while, according to the theory of Agassiz and Vogt, the young Plagiostomi ought to have a preeminently heterocercal tail.

A. Agassiz admits with Huxley that the form of tail called homocercal by Agassiz and Vogt is due only to a deceptive external appearance; he also recognizes with Van Beneden that the young Plagiostomi, during the earliest periods of their development, have a strictly homocercal tail; but he nevertheless holds that neither of these two anatomists has upset the old theory of Agassiz and Vogt, and that we must retain this great generalization of the concordance of the embryonic with the palæontological development. It is only necessary to take another step, and to interpret somewhat differently from Agassiz and Vogt the arrangement of the tail which so predominates in the bony fishes of the present epoch.

It must first of all be recongnized that heterocercity does not correspond to the first stage, and that neither Von Baer nor Agassiz and Vogt have asserted that it does so, but that they have merely indicated this arrangement as characterizing *one of the first* stages of development. In point of fact, the fish, on issuing from the egg, has a nearly symmetrical tail, the notochord extending in a straight line in the direction of the caudal extremity. This stage, which represents the first form of the tail of the Teleostei as well as of the other groups, and which precedes that of the heterocercal tail properly so called, is what A. Agassiz proposes to call the *leptocardial state.*

Thus, from the embryogenic point of view, the tail of the Selachii is formed perfectly in accordance with the laws of development of the other fishes; and it only remains to see how far this agrees with palæontological history.

If we examine the tails of the Devonian fishes we are struck with the exact parallelism that exists in this respect between these ancient representatives of the group and the successive stages of the tail in *Pleuronectes.* Among Devonian fishes there are some (e. g. *Glyptolæmus*, *Gyroptychius*) of which the tail is distinctly leptocardial; others (such as *Holoptychius* and *Osteolepis*) have slightly modified tail, presenting a very feeble tendency towards heterocerceity; then come *Glyptolepis* &c., in which the hetero-

cercosity is more distinct; and, finally, in the genus *Dipterus* the heterocercal character becomes strongly marked.

The parallelism between the fossil genera and the embryonic stages of the existing osseous fishes is still more striking if we examine forms such as *Phaneropleuron* and *Tristichopterus*, in which the tail is lobed, the dorsal column penetrating into the dorsal lobe, as in the young *Pleuronectes*. The genera *Acanthodes, Diplacanthus, Cheirolepis*, &c. of the Old Red Sandstone represent the stages of *Pleuronectes* in which there is a first indication of the separation between the true caudal and the embryonic caudal.

In the subsequent modifications of the tail in fossil fishes there is a tendency to the gradual diminution of the embryonic or superior lobe, and to the predominant development of that which is to become the caudal lobe proper.

On comparing the most ancient forms with the genera *Platysomus, Semionotus, Lepidotus*, and, lastly, *Pachycormus*, we recognize, as in the development of the Teleostei of the present epoch, a gradual approach to an externally homocercal tail.

To these facts, demonstrating the parallelism that exists between the embryonic and the palæontological development of the tail, Mr. Agassiz adds others derived from characters of ancient Ganoids which recur in the embryos of the Teleostei.

If we wish to formulate the conclusions of Mr. Agassiz in Häckelian language, we may say that they supply a fresh proof in favour of the law according to which "ontogenesis is the abridged and rapid recapitulation of phylogenesis."—*Proc. Amer. Acad. of Arts and Sci.* vol. xiii. October 1877; *Bibl. Univ.* March 15, 1878, *Arch. des Sci.* p. 368.

On Selaginopsis, Polyserias, *and* Pericladium. By M. C. Mereschkowsky.

According to Mr. Norman's "Note on *Selaginopsis* (=*Polyserias Hincksii*, Mereschk.) and on the Circumpolar Distribution of certain Hydrozoa," which appeared in the 'Annals' for March 1878, my genus *Polyserias* had been previously described by Prof. Allman under the name of *Selaginopsis* (Journ. Linn. Soc. vol. xii. 1876); hence the species that I described in the last number of this Journal must be named *Selaginopsis mirabilis*, Verr., and *Selaginopsis Hincksii*, mihi. However, I am not yet quite certain of this: and unfortunately it is impossible for me at present to verify Mr. Norman's opinion; for in the whole Russian empire there does not exist vol. xii. (1876) of the Journal in which Prof. Allman has published his diagnoses. The Academy of Sciences of St. Petersburg does not receive this journal at all; and the Public Library only possesses it down to the year 1875.

It seemse specially doubtful to me whether the genus *Pericladium* is really distinct from *Selaginopsis*; and perhaps it would be better to retain under the name of *Polyserias*, proposed by me, a genus which would combine Allman's two genera, and more particularly

because this name better expresses the characters common to all the species which would fall under it than either of the other two names.

On a new Gorilla from Congo. By MM. Allix and Bouvier.

MM. Lucan and Petit have lately sent from Landana (Congo), as part of the results of their hunting on the banks of the Kouilo, near the village of King Mayema, the skeleton and skin of an adult female gorilla, which possesses peculiar interest, both from its own nature and because it serves to confirm the recent discovery of this anthropoid in the above region.

Although Battell, about 200 years ago, noticed the presence of great apes, apparently gorillas, in Congo, and in 1851 Dr. Ford maintained that this animal was met with from the Camaroons to Angola, Geoffroy St.-Hilaire in 1858 regarded their existence as demonstrated only on the shores of the Gaboon and the banks of the Moundah or Danger River. Since that date the researches of Du Chaillu, Marche, and the Marquis of Compiègne have carried the habitat of this great ape further south, as far as the Fernand-Vaz. In 1877 Dr. Falkenstein brought to Europe a young living gorilla, which he had purchased in the region of the Kouilo (4° 35′ S. lat.); and one of the authors quite recently received the skin of a young female from the same locality.

"At that time," they say, "we did not think of separating this species from the type; and, indeed, its youth could not allow of its furnishing satisfactory characters for specific separation. This, however, is not the case with the adult specimen which forms the subject of the present communication.

"This female, which is aged, is remarkable as being of smaller size than the *Gorilla gina*; and its head is proportionally still smaller. It also differs in numerous characters, which we purpose to give in detail in the 'Bulletin' of the Zoological Society of France, and which consist principally in the depth of the temporal fossæ, the narrowness of the cranium behind the orbital arches, the narrowness of the interorbital space, and a greater prominence of the keel which rises in the middle of this space, the length and flattening of the zygomatic arches, and also a very noticeable diminution of the height of the spinous apophyses of the first cervical vertebræ.

"Its coat, grey and brown on the body, black on the limbs, with red parts on the head and pubis, does not differ essentially from that which several authors have rather vaguely described, except by a very sharp separation on the flanks between the brown of the belly and the grey of the back, and by the red tint of the pubic regions; but it presents this remarkable peculiarity—that the back is thickly covered with long hair, contrary to what is seen in the other gorillas, in which the skin of this region is denuded and simply covered with short and worn hairs.

"From this we may conclude that our animal does not take its repose like the *Gorilla gina* (that is to say, supported against its back), but that, like the chimpanzees, it has much more arboricolar habits, which is also more in accordance with the reduction of its size.

"All these differences justify us in regarding our specimen as belonging to a distinct species, to which we give the name of *Gorilla mayema*, from that of the negro chief of the village near which it was killed."—*Comptes Rendus*, January 7, 1878, p. 56.

On the Rhizopoda of the Salt Lake of Szamosfalva. By Dr. Geta Entz.

Dr. Entz has described the Rhizopoda obtained by him from a salt pool at Szamosfalva, near Klausenberg, in Hungary. He procured in all twelve species, five of which, all shelled species, are described as new, and two of them as the types of new genera. These are *Pleurophrys helix*, *Plectrophrys* (g. n.) *prolifera*, *Euglypha pusilla*, *Microcometes tristrypetus*, and *Orbulinella* (g. n.) *smaragdea*; the other forms noticed are *Ciliophrys infusionum*, Cienk., *Podostoma filigerum*, Clap. & Lachm., and five species of *Amœba* (*guttula*, *limax*, *princeps*, *diffluens*, and *radiosa*).

A previous examination of the Infusoria of the salt pools of Torda and Szamosfalva had furnished the author with some belonging to exclusively marine types; but the greater part were such as occur both in salt and fresh water, and only about one fourth of the Infusoria observed belonged to forms previously known only from fresh water.

In the case of the Rhizopods, the majority belong to forms which are very common in fresh water, but which must probably be referred to the category of organisms which occur indifferently in both fresh and salt water; and, so far as this supposition applies to the *Amœbæ*, Dr. Entz furnishes a confirmation of it in a subsequent short note, in which he states that he found *Amœba limax* and *A. radiosa* very abundantly in sea-water from Cuxhaven. (He regards the marine forms *A. marina*, Duj., *A. polypodia*, F. E. Schulze, and possibly also *Protamœba polypodia*, Häck., as probably identical with *A. radiosa*.)

Of the forms peculiar to the Szamosfalva salt pool, two (namely *Euglypha pusilla* and *Microcometes tristrypetus*) find their nearest relations in freshwater organisms. *Pleurophrys helix*, on the contrary, belongs to a marine type. Of the two new genera, *Orbulinella* is most nearly related to the marine perforated Foraminifera, and *Plectrophrys* is referred to the neighbourhood of *Pleurophrys*, *Plagiophrys*, and *Chlamydophrys*, and may be either a marine or a freshwater type. As a negative character bearing on the marine or freshwater affinities of the Rhizopodal fauna of Szamosfalva, the author remarks on the total absence of *Arcellæ* and *Difflugiæ*, both of which are so abundant in, and characteristic of, fresh water.—*Hungarian* '*Naturhistorische Hefte*,' 1877, iii. & iv.

Note on the Locality and Synonyms of Sternotomis cornutor, *Fabr.* (*Coleoptera, Lamiidæ*). By Charles O. Waterhouse.

The type specimen of *Sternotomis cornutor*, Fabr., is in the British Museum, said to have come from America. The species has since been described by Prof. Westwood under the name *S. comes*, said (with doubt) to have come from Madagascar. Two examples (♂ and ♀) have recently been added to the British-Museum collection from the Island of Johanna, off Madagascar. The two specimens agree exactly with the type which is figured by Olivier. While recording this locality I take the opportunity of correcting the synonymy of the species as given in the 'Munich Catalogue.' In that work the names are placed thus:—

1. *cornutor*, Fabr., Oliv., Klug.
   maculata, Oliv., Casteln.
2. *Norrisi*, Westw.
   comes, Westw.

The following will be found correct:—

1. *cornutor*, Fabr., Oliv., *nec* Klug.
   comes, Westw.
2. *maculata*, Oliv., Casteln.
   cornutor, Klug.
3. *Norrisi*, Westw.

The authors of the Catalogue were doubtless misled by Klug, who, after giving a diagnosis of "*cornutor*, Fabr.," wrongly identified, places *maculata*, Ol., as a synonym of it. How *comes* came to be associated with *Norrisi*, with which, according to Thomson, it is scarcely congeneric, it is difficult to imagine.

British Museum,
April 1878.

On the Genus Haliphysema.

To the Editors of the Annals and Magazine of Natural History.

Sirs,—I regret to find that through inadvertency there is a discrepancy between the Plate illustrating my paper in the April 'Annals' and its description. To make the Plate intelligible I must ask your readers to change the figures 3 into 7, and 4, 5, 6, 7 to 3, 4, 5, 6.

Yours faithfully,
A. M. Norman.

April 3, 1878.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

No. 6. JUNE 1878.

XLIX.—*On the Reticularian and Radiolarian Rhizopoda (Foraminifera and Polycystina) of the North-Polar Expedition of* 1875–76. By HENRY B. BRADY, F.R.S.

[Plates XX. & XXI.]

FORAMINIFERA.

AMONGST the collections brought home by Capt. H. W. Feilden, R.A., the naturalist to the North-Polar Expedition which sailed in 1875 under the command of Capt. Sir G. Nares, R.N., were a number of gatherings of material which had been laid aside from time to time for examination with respect to Microzoa and Microphyta. There were in all some fifty or sixty packages; and after the Diatomaceæ had been determined, Capt. Feilden was kind enough to place them in my hands for the investigation of the Foraminifera and Polycystina. The material consisted for the most part of soundings; but there were a few samples of dust and dirt from discoloured ice, and of mud from beds of glacial deposit of greater or less age. The soundings were from depths of from 10 to 220 fathoms; and the quantity of each was comparatively small. The samples from mud-beds were larger, and yielded pretty good series of Foraminifera; but as they exhibit a fauna which is practically identical with that of the present sea-bottom at moderate depths in the same latitudes, they require no separate treatment. The dust from ice-hummocks and similar positions gave no Rhizopoda worth recording.

All the material was carefully washed to clear it of impalpable inorganic matter. This process seriously reduced many of the already small samples; and some of them left scarcely any residue for examination. Nevertheless of the fifty or sixty gatherings about forty yielded sufficient organic remains to give a general, though of course not an exhaustive, idea of the microzoic fauna of their respective localities. In some instances a number of the soundings were from points so near together and at depths so similar, that the results from several could be incorporated with advantage; but after condensation on this wise, and the omission of a few of those which gave obviously incomplete lists, there remains the groundwork for a fairly representative distribution-table comprising twenty-four stations. This must be regarded, under the circumstances, as very satisfactory. The primary object of the expedition was geographical rather than biological; there was no opportunity for dredging; and the chances of obtaining material in other ways were beset with difficulties hardly to be appreciated by those who, like myself, have been accustomed to collect in temperate regions.

The following is a list of the Stations arranged in order of latitude, beginning at the most southern point of the series. The geographical details, thanks to careful labelling, can be stated with much accuracy. The capital letters A to X refer to the heading of the columns in the accompanying Table. The area comprised in the Table may be divided into three sections. The first sixteen columns (A to P) refer to localities in Baffin's Bay and Smith Sound. These are separated by the whole length of Kennedy Channel (nearly two degrees) from Discovery Bay (Q), the only representative of the latitude of Hall Basin. Robeson Channel (nearly one degree) intervenes between this and the nearest of the seven remaining Stations.

A. Glacial mud, Tyndall Glacier, 27 fathoms, Sept. 12, 1876, situate in Bardin Bay, east side of Baffin's Bay, lat. 77° 15′ N.

A little box of reddish clay with worn shell-fragments, containing relatively but few organisms; the Foraminifera belong chiefly to the genera *Verneuilina*, *Cassidulina*, *Truncatulina*, and *Nonionina*.

B. Off Cape Isabella, 220 fathoms, lat. 78° 20′ N.

This is the deepest sounding containing Foraminifera; but it is richer in Diatomaceæ (notably *Coscinodiscus radiatus*) than in Rhizopoda. Of the latter, *Cassidulina*, *Truncatulina*, and *Nonionina* are again the most prominent types.

C. Off Cape Sabine, Smith Sound, 50 fathoms, lat. 78° 44′ N.

D. Off Brevoort Island, Smith Sound, 210 fathoms, lat. 78° 44′ N.

The former of these, from shallower water, contains but few species; the latter gives a tolerably rich list of Foraminifera—*Polystomella arctica* particularly fine and abundant, the genera *Lagena*, *Cassidulina*, *Truncatulina*, *Pulvinulina*, and *Nonionina* all well represented. There were in addition a few Ostracoda *.

E. Off Cape Victoria, Bache Island, 35 fathoms, lat. 79° 14′ N.

The genus *Truncatulina* by far the most abundant, associated with *Noninonia*, *Polystomella*, and other shallow-water types. Contained also Ostracoda of five species and a few *Coscinodisci*.

F. Between Walrus Shoal and Victoria Head, Sept. 8, 1876, 57 fathoms, lat. 79° 26′ N.

A poor lot, containing little beyond *Cassidulina*, *Nonionina*, and the weaker forms of *Polystomella*, with one or two Radiolaria. The only specimen of *Pulvinulina Micheliniana*, a common surface form in the North Atlantic, found in the entire collection, was in this material.

G. and H. Franklin-Pierce Bay, lat. 79° 28′ N.

The former (G) refers to two soundings, in 13 fathoms and 15 fathoms respectively; the latter (H) to two in 46 fathoms. The contents of all four were much alike, sandy mud with small worn stones; those from the greatest depth contained the largest variety of organisms. The salient types of Foraminifera in all are *Lituola*, *Truncatulina*, and *Polystomella*. The shallow-water material furnished the only specimens found of the genus *Discorbina*. It contained in addition a number of diatoms, which my friend Mr. F. Kitton, of Norwich, tells me are as follows:—*Triceratium arcticum*; *Biddulphia*, sp.; *Rhabdonema Crozieri*; *Grammatophora marina*; and *Actinoptychus undulatus*. A few valves of Ostracoda were also met with.

I. Allman Bay, Sept. 14, 1876, 25 fathoms, lat. 79° 30′ N. The Bay between Cape Hawks and Cape d'Urville.

A tube full of sand and stones, but rich in Foraminifera. The genus *Lagena* in considerable variety, with *Polymorphina*,

* The Ostracoda were carefully preserved throughout, and form the subject of a separate notice by my brother, Dr. G. S. Brady.

Cassidulina, *Pulvinulina*, and *Nonionina* as its prominent associates.

J, K, and L. Dobbin Bay, Aug. 28 to Sept. 1, 1876, lat. 79° 35′ N.

The column J includes three soundings, namely in 45, 46, and 47 fathoms, whilst K and L are from 113 and 125 fathoms respectively. The muddy material obtained in 46 fathoms contained the largest number of forms; in that from the greatest depth organisms of all sorts are rare. The leading types of Foraminifera are *Cassidulina*, *Pulvinulina*, and *Polystomella*.

M and N. Off Hayes Point, Aug. 18 and 19, 1876, lat. 79° 42′ N.

Two soundings, the one in 22, the other in 35 fathoms, containing a few Diatomaceæ and Ostracoda and a sprinkling only of Rhizopoda, the latter chiefly *Cassidulina* and *Truncatulina*, with *Virgulina*, *Pulvinulina*, and *Polystomella* in smaller numbers.

O and P. Off Cape Frazer, Aug. 24th, 1876, lat. 79° 45′ N.

The column marked O is compiled from a single sounding at 50 fathoms; that headed P is from three soundings, all at a depth of 80 fathoms. The latter taken together yield by far the best representative list of the whole series, comprising in all thirty-three species of Foraminifera. The most characteristic amongst them are *Polystomella arctica*, which is of large size and abundant, and the hitherto undescribed type *Hyperammina*. Almost all the genera contained in the other lists are present to a greater or less extent, the most important exception being *Polymorphina*. The same locality also gave the richest list of Ostracoda—eleven species, one of which is new to science.

Q. Discovery Bay, lat. 81° 41′ N.

Comprises two samples—one from 23 fathoms, the other from 25 fathoms. Rhizopoda rare and minute, chiefly *Cassidulinæ*, other genera being represented by very poor specimens.

R. Fiord Valley, near Lincoln Bay, lat. 82° 8′ N.

Mud taken from between the valves of shells; yielded little beyond *Cassidulinæ* and the weak varieties of *Polystomella*. The Ostracoda were of more importance and embraced one new species.

S. Mud from ravine north of Repulse Bay, lat. 82° 10′ N.

A little sandy glacial mud from Hall's Land, with the

label "brought by Mr. Egerton, April 1876." It contained but few specimens, and these of only four species. Though manifestly insufficient to show the extent of the fauna, they have been allowed a column in the Table as representatives of a region somewhat separated from the rest. Ostracoda were present, but in very small numbers.

T. Winter quarters of the 'Alert,' 1875–6, 6 fathoms, lat. 82° 27′ N.

Four tubes containing dried mud. Foraminifera chiefly of the genera *Globigerina*, *Cassidulina*, *Nonionina*, and *Polystomella*. Some of the tubes gave also a few Diatomaceæ (*Triceratium arcticum*) and occasional valves of Ostracoda.

U. Mud-beds, 150 feet elevation, lat. 82° 27′ N.

This material was found to be almost devoid of organic remains of any sort; the few specimens of Foraminifera were of quite the commonest species.

V. Floeberg Beach, July 1876, lat. 82° 29′ N.

A small tube of sand from the shore, and a pill-box with mud and stones from a depth of 10 fathoms, only furnished together what appears to be an incomplete list; and the specimens were all very small. There were a few Ostracoda also present.

W. Cane Ravine, June 1876, lat. 82° 33′ N.

A lot of finely divided silt, taken out of a specimen of *Astarte borealis*, from mud-beds 100 feet above the sea-lèvel, in Grinnell Land; containing small examples of a few of the common arctic types of Foraminifera and Ostracoda.

X. Sounding, May 11, 1876, 72 fathoms, lat. 83° 19′ N.

The most interesting sounding in the entire collection, not merely as being the most northerly, but also, considering the minute quantity that could be obtained for examination (only a few grains altogether), as presenting the most varied range of Microzoa. It consisted of fine soft mud containing Diatomaceæ (*Coscinodiscus radiatus*), Radiolaria in greater variety than any other sounding, and Foraminifera of no less than eleven genera, the most abundant of the latter being a dwarf variety of *Globigerina*.

In tracing on the map the area represented by this collection, and comparing it with that covered by previous researches, it becomes manifest that the ground is altogether new. Our present knowledge of arctic Rhizopoda is chiefly derived from the labours of Profs. W. K. Parker and T. Rupert Jones, and of the Rev. A. M. Norman. The memoir of Messrs. Parker and

Jones, in the 'Philosophical Transactions' for 1865, forms the text-book of the subject. It contains the results of the examination of the soundings taken by Sir E. Parry in Baffin's Bay, between latitudes 74° 45′ and 76° 30′ N.; of those of Dr. Sutherland off the Hunde Islands, on the west coast of Greenland, in lat. 68° 50′ N.; and of dredgings made by Mr. M'Andrew off the coast of Norway, between lat. 65° and 71° N. Mr. Norman's material consisted of dredgings brought home by Dr. J. Gwyn Jeffreys from his cruise in the 'Valorous,' the vessel, it will be remembered, which sailed in company with the 'Alert' and 'Discovery,' as far as Disco Island, on their northward voyage. The record of Mr. Norman's observations on the Rhizopoda, which, so far as they affect our present purpose, refer to an area lying between about lat. 59° and lat. 70° N., forms one section of the general scientific report submitted to the Royal Society. A notice by Dr. Carpenter of a few of the larger forms appeared at the same time.

Messrs. Parker and Jones's memoir is accompanied by a series of elaborate distribution-tables, one of which is devoted to the Arctic fauna. Of the twenty localities it comprises, seven belong to the group of soundings from Baffin's Bay, five to the Hunde Islands, and eight to the Norwegian coast. In all seventy-five species of Foraminifera are enumerated; and of these twenty appear in the Norwegian list only. A condensed statement of the results embodied in Messrs. Parker and Jones's Table will be found in the three columns (*a*, *b*, *c*) appended to that which accompanies the present paper. A ready means of comparison is thereby afforded, and the subject need not, therefore, be further dwelt upon.

The 'Valorous' report cannot, unfortunately, be treated in the same way, as it contains no detailed lists of the Foraminifera. I propose, therefore, in order to complete the summary of what has been hitherto written on the subject, to cull from the Rev. A. M. Norman's paper (Proc. Roy. Soc. vol. xxv. pp. 207–213) such particulars as he gives relative to the distribution of species in those localities that come within the sphere of our present inquiry. Having had the opportunity of looking over the fine collection of Foraminifera obtained from the 'Valorous' material, I may be permitted to express my regret that circumstances have hitherto prevented Mr. Norman from giving his results to the world. They are of great interest and cost much labour; and the details would have been a valuable contribution to the literature of the Rhizopoda. Four of these dredgings were from points within the Arctic Circle; and two others, from the Stations num-

bered 8 and 9 respectively, though not strictly arctic in latitude, pertain to an adjacent and much richer zoological area, and are within Davis Straits, which may be regarded as a sort of natural boundary. The following notes are abstracted from Mr. Norman's summary.

HOLSTEINBORG HARBOUR (lat. 66° 40′ N.), 7–35 fathoms.

The more remarkable Foraminifera were:—*Trochammina gordialis*, J. & P.; *Lituola canariensis*, D'Orb.; *Textularia biformis*, P. & J.; and *Bolivina punctata*, D'Orb.

GODHAVN HARBOUR, DISCO (lat. 69° 10′ N.), 5–20 fathoms.

Thirty-six species identified, amongst them:—*Dentalina consobrina*, D'Orb. (fide P. & J.), *Polymorphina burdigalensis*, D'Orb.; *Pullenia sphæroides*, D'Orb.; *Verneuilina polystropha*, Reuss; *Cassidulina obtusa*, D'Orb.; *Pulvinulina Karsteni*, Reuss; and *Discorbina obtusa*, D'Orb.

LIEVELY HARBOUR, DISCO (lat. 70° N.*), 5–20 fathoms.

The Foraminifera exhibited a marked parallelism with those recorded by Mr. G. M. Dawson from Gaspé Bay†, in the Gulf of St. Lawrence. Twenty-eight species were noted, including:—*Rhabdopleura abyssorum*, Parker; *Lituola cassis*, Parker; *Nonionina labradorica*, Parker; and *Bulimina pyrula*, D'Orb.

STATION No. 5. Lat. 66° 59′ N., long. 55° 27′ W., 57 fathoms.

Thirty-five Foraminifera observed, ten belonging to the genus *Lagena*. The list contains, amongst others:—*Lagena striatopunctata*, P. & J.; *Lituola globigeriniformis*, P. & J.; *Cyclammina cancellata*, H. B. Brady, MS.; and *Bulimina elegantissima*, D'Orb.

STATION No. 8. Lat. 62° 6′ N., long. 55° 56′ W., 1350 fathoms.

Contained many of the more common Foraminifera. The following are noted:—*Nodosaria Schlichtii*, Reuss; *Orbitolites tenuissimus*, Carpenter; *Pullenia quinqueloba*, Reuss; and *Lituola nautiloidea*, Lamk.

STATION No. 9. Lat. 59° 10′ N., long. 50° 25′ W., 1750 fathoms.

Remarkable for the abundance and variety of arenaceous

* The latitudes of Holsteinborg, Godhavn, and Lievely Harbours are not given in the Report, and the last of the three does not appear in any map I have access to; but, for the purpose of comparison with the range of the other localities, the figures stated are near enough.

† It must be remembered, nevertheless, that Gaspé Bay is in lat. 48° to 49° N., or fully a degree south of the coast of Cornwall, though more or less Arctic in climatal conditions.

types, e. g. *Rhabdammina*, *Pilulina*, most of the various forms described as *Lituolæ* by Dr. Carpenter, and *Astrorhiza catenata*, Norman. In addition to these, *Cristellaria obvelata*, Reuss, *Orbulina neojurensis*, Karrer, and the dwarf variety of *Globigerina bulloides*, alluded to on a later page of the present paper, were also found.

To turn now to the more strictly zoological portion of the subject. An examination of the accompanying Distribution-Table, still more the inspection of the mounted specimens, brings into relief certain characteristics of the Polar foraminiferal fauna. Some remarks will presently be made on the individual species where they exhibit any special or noteworthy features; but attention may be drawn at the outset to one or two facts of more general import. There are about half a dozen species that may be regarded as essential constituents of the microzoic fauna of these high latitudes, having been found at almost every depth at which the floor of the sea has been examined. They are as follows—*Globigerina bulloides* (a dwarf variety), *Cassidulina lævigata* and *C. crassa*, *Truncatulina lobatula*, *Pulvinulina Karsteni*, and *Polystomella striatopunctata*. They are usually accompanied by one or two forms of *Nonionina*, varying according to depth and other circumstances, and, if the sea-bottom be composed of rough sand or gravel, by *Polystomella arctica*. Other species occur in every sample of mud or sand wherever obtained; but it is not too much to say that those above enumerated constitute ninety-five per cent. of the entire collection made from these soundings. The constant occurrence of *Cassidulina lævigata*, of full size and well-grown, even when the other Foraminifera accompanying it were poor, starved specimens, and the presence of *Pulvinulina Karsteni* in almost every dredging to the practical exclusion of all other species of the same genus, are points of considerable significance. The almost complete absence of the Milioline genera (for the occurrence of a single, minute, thin-shelled specimen here and there in a few of the soundings amounts to absence in such a case) is an unexpected feature. In dredgings at similar depths but little to the south of those under consideration the simple porcellanous forms are comparatively common; and their area of distribution is otherwise world-wide; yet it is hardly too much to say that no approach to a full-sized mature specimen of any of the modifications of the Milioline type has been met with in the North-Polar material.

One or two of the species are undescribed hitherto; and a few others present characters somewhat modified by their

boreal habitat. The following notes refer to some of these; the numbers prefixed correspond with those employed in the Table. The new forms and the more interesting varieties are figured in Plates XX. and XXI.; for the rest, nearly all the species are well illustrated in Messrs. Parker and Jones's memoir before referred to, or in Prof. Williamson's 'Recent Foraminifera of Great Britain.'

9. *Lituola glomerata*, nov. (Pl. XX. fig. 1, *a–c*.)

Characters. Test free, arenaceous, thin-walled, non-labyrinthic; spiral in arrangement, subglobular in form, often somewhat lengthened in the direction of the axis; usually more or less unsymmetrical. Segments few, three or four in each convolution, long, narrow. Sutures but little excavated except at the ends. Aperture at the inner margin of the terminal chamber, near the exterior of the corresponding segment of the previous convolution, simple, often obscure. Diameter of the test seldom more than $\frac{1}{100}$ inch (0·25 millim.).

This, which is perhaps the most minute of the segmented Lituolida, is an obscure and difficult form to treat. The septation is often imperfect and sometimes cannot be traced on the exterior. The drawings (Pl. XX. fig. 1, *a–c*) are from unusually good specimens, and they are sufficiently characteristic. When the Lituoline genera come to be rearranged in the light of the material which now exists for their more extended and accurate study, it is possible that this, in common with some other of our northern species, may find its place in Reuss's genus *Haplophragmium*; but its nearest allies are forms best recognized at present under the generic term *Lituola*. In distribution *Lituola glomerata* is by no means confined to the arctic seas, but has been met with in the 'Challenger' dredgings from many parts of the world.

10. *Hyperammina elongata*, nov. gen. et sp. (Pl. XX. fig. 2, *a*, *b*.)

Characters. Test arenaceous, in the form of a straight or nearly straight tapering tube, the wide end closed and rounded, the open narrow end constituting the general aperture. Exterior sandy and rough, interior smooth. Length (of the Arctic specimens) about $\frac{1}{10}$ inch (2·5 millims.).

This is one of the many arenaceous types brought home in 1869 by the naturalists in charge of the first cruise of the 'Porcupine;' but it has not hitherto, so far as I am aware, received a name. Its club-like or, still more, its pestle-like contour and sandy texture, suggest the term *Hyperam-*

*mina**. The polar specimens are very small when compared with those from the North Atlantic, or with those from many of the 'Challenger' stations—examples considerably more than half an inch (15 or 16 millims.) being not unfrequent in other localities.

14. *Lagena apiculata*, Reuss.

The somewhat compressed as well as the globose forms are included under this name.

17. *Lagena striatopunctata*, Parker & Jones. (Pl. XX. fig. 3.)

A few specimens similar in character to those figured by Messrs. Parker and Jones were met with in two of the deeper soundings.

18. *Lagena Feildeniana*, nov. (Pl. XX. fig. 4.)

Characters. Test subglobular, pyriform, with surface-ornamentation consisting of a few stout longitudinal costæ alternating at regular distances with longitudinal rows of large perforations. Longer diameter about $\frac{1}{70}$ inch (0·37 millim.).

A very pretty little shell, with somewhat striking superficial ornament. It bears considerable resemblance to two other costato-perforate species, namely *Lagena striatopunctata*, P. & J., and *L. Howchiniana*, Brady. The former of these has a double row of minute pores bordering each riblet (Pl. XX. fig. 3); the latter, which is a Carboniferous species, has a single row of orifices down the top of each ridge; whilst *L. Feildeniana* is distinguished by stout entire costæ with a single series of large pores in the furrows between them. As this particular varietal form does not appear to have been hitherto observed or described, it may very properly be associated by name with the naturalist to whom we owe the North-Polar collections.

Hab. Off Cape Frazer, 80 fathoms.

19. *Lagena caudata*, D'Orbigny.

A single entosolenian specimen, not unlike that figured by Williamson as *Entosolenia globosa*, var. *lineata*, Rec. For. Gt. Br. pl. i. fig. 17.

22. *Glandulina lævigata*, D'Orbigny.

From 80 fathoms off Cape Frazer, very rare; an elongate variety resembling *G. gracilis* of Reuss, though not quite so attenuated and sharp-pointed.

* ὕπερος (a pestle), ἄμμος (sand).

25. *Cristellaria rotulata*, Lamarck.

Also one or two specimens approaching *C. crepidula* in contour.

26. *Polymorphina lactea*, Walker & Jacob.

Both typical pyriform specimens, and the compressed modification known as *P. lactea*, var. *amygdaloides*, Reuss.

29. *Polymorphina acuminata*, D'Orbigny. (Pl. XX. fig. 5, *a*, *b*.)
30. *Polymorphina rotundata*, Bornemann. (Pl. XX. fig. 6, *a*, *b*.)

Two interesting and somewhat rare forms, sufficiently illustrated by the figures. It is necessary, however, to bear in mind that the successive modifications of the genus *Polymorphina*, though generally pretty easily recognized, are of little more than varietal significance.

32. *Globigerina bulloides*, D'Orbigny, var. (Pl. XXI. fig. 10, *a*, *b*, *c*.)

Occasional specimens of the genus *Globigerina* occurred in most of the soundings; in one only were they present in sufficient abundance to constitute what we are accustomed to speak of as a *Globigerina*-ooze, namely in that from the most northerly point attained by the Expedition. The specimens differ considerably from the typical form—so much so that they can hardly be associated with it except as a variety. The shells are very small, compactly made, and nearly spherical; the individual segments are scarcely ventricose, and do not exhibit the globular contour that we are accustomed to regard as characteristic of the genus, nor do they open into a central or umbilical vestibule, but communicate directly with each other. The general aperture forms a semicircular or crescentic opening at the inferior margin of the terminal chamber. The Rev. A. M. Norman probably alludes to the same modification of the type in his description of specimens from a depth of 1750 fathoms in lat. 59° 10′ N., long. 50° 25′ W., one of the 'Valorous' stations just within Davis Straits*.

34. *Uvigerina pygmæa*, D'Orbigny, var. (Pl. XX. fig. 7, *a*, *b*.)

The *Uvigerinæ*, a very few specimens of which were found in several of the soundings, are uniform in their characters and

* Proc. Roy. Soc. vol. xxv p. 212.

contour. They are minute, thin-shelled, and obscurely triangular; but the segments are more inflated than in the *Uvigerina angulosa* of Williamson, and the surface ornamentation is very partially distributed. They differ almost as much from the typical *U. pygmæa**; but the points of divergence are such as may and probably have been brought about by the different life-conditions of a polar climate. Such specimens may be accepted as representing a starved or impoverished variety of the typical form rather than a distinct species.

38. *Bulimina elegantissima*, D'Orbigny. (Pl. XXI. fig. 12.)

Very rare, and not of the precise contour by which the species is usually recognized: the segments are similarly arranged; but they are relatively shorter, and there are fewer in each convolution, as indicated in the figure.

41. *Textularia biformis*, Parker & Jones. (Pl. XX. fig. 8.)

A very minute, thin-shelled arenaceous species. Messrs. Parker and Jones's figures are on somewhat too small a scale to show the conformation of the test quite distinctly. The largest of the Polar specimens is but little over $\frac{1}{70}$ inch (0·37 millim.) in length.

42. *Verneuilina polystropha*, Reuss. (Pl. XX. fig. 9, *a–c*.)

Small specimens of this arenaceous triserial Textularian are common in one or two of the localities. They are often of the slender, more elegant form delineated in fig. 9, *a*.

45. *Pulvinulina Karsteni*, Reuss. (Pl. XXI. fig. 11, *a–c*.)

Over extensive areas, in almost every portion of the globe, the floor of the ocean is largely composed of the shells of Foraminifera belonging to two genera, *Globigerina* and *Pulvinulina*; but for the most part these are merely the dead skeletons of pelagic species which, when living, inhabit a layer of water that, comparatively speaking, may be regarded as superficial; but it is far otherwise in these high latitudes. A single chance specimen of *Pulvinulina Micheliniana* is the only representative of the pelagic section of the genus found in the entire collection of soundings; whilst *Pulvinulina Karsteni*, one of the many species that, so far as we know, live on the sea-bottom, is present everywhere, and the size and condition of the specimens indicate that it is at home in these northern regions.

* Compare Williamson's figures, Rec. For. Gt. Br. pl. 5. figs. 138–140, with fig. 7, *a*, *b*, of the present paper.

53. *Polystomella arctica*, Parker & Jones.
(Pl. XXI. fig. 13, *a–d*.)

An essentially boreal species, its distribution probably not extending further south than Shetland. It is a large, coarse, thick-shelled modification of the type, most nearly related to *P. striatopunctata*. There are, however, certain structural peculiarities observable in mature specimens, the most important of which is the duplication of the sutural apertures. Instead of the single line of orifices immediately over each septum, there are frequently two parallel rows, which, if the sutures are marked externally by raised bands of exogenous deposit, appear one on each side of the limbation. From the exterior it appears as though the two rows of pores opened respectively into the two adjacent chambers; but with a little care sections may be made (fig. 13, *d*) showing clearly that this is not the case, but that the double tubulation is the result of the lengthening and bifurcation of what was originally a simple orifice. The horizontal section of the entire shell (fig. 13, *c*) shows its general structure. The laminated thickening appears to be confined to the last convolution, and to be caused by the chamber-wall of some of the segments being extended over that of the previously formed chambers, as in the Nummulite. The investment of the later chambers is therefore thinner than that of those preceding them, the last formed being the thinnest.

The typical *Polystomella crispa*, so common in the shallow water of temperate latitudes, does not appear at all in the material from these polar localities. It seems to be replaced by *P. arctica*, with *P. striatopunctata* in still larger numbers; and these pass by insensible gradations into the various forms of *Nonionina*.

Radiolaria.

Here and there in the finer portions of some of the soundings the siliceous tests of Radiolaria were observed; but at one station only, and that the most northerly of all, were they met with in any abundance. In most cases there was no great difficulty in assigning the various forms which were obtained to their generic types; but it was found impossible to determine the species satisfactorily from published authorities. Under these circumstances, the natural course to pursue was to forward the mountings to Prof. Haeckel, of Jena, for his opinion on the more doubtful specimens. The learned Pro-

fessor has been kind enough to examine the mountings; and his remarks upon them contain much of interest. He states that the species are, as far as they go, exactly identical with those he finds in the 'Challenger' soundings from the Stations numbered 268 to 274 in Sir Wyville Thomson's printed list—that is to say, with the particular species which are found at the sea-bottom in the middle of the Pacific, from about 8° N. of the equator to 8° S. of the same, at depths of 2400 to 2900 fathoms. Prof. Haeckel confirms the view which I had already arrived at, that, until we have the wider basis for accurate nomenclature which the publication of the 'Challenger' Radiolaria will afford, it is better to give nothing more than an enumeration of the genera observed.

There has been no previous record of Arctic Radiolaria, except in the tabular statements which accompany the Rev. A. M. Norman's paper (*op. cit.* xxv. pp. 204, 205). In these Tables eight species of Polycystina are set down as occurring on the west coast of Greenland and in Davis Straits; but I gather from the author that the entry is only intended to convey the fact of this number of distinct forms being observed, and that no determination of genera or species was attempted.

The following notes represent the distribution of the group so far as revealed by the polar soundings:—

AA. Off Cape Dudley Digges, July 26, 1875, 260 fathoms, lat. 76° 7′ N.

This sounding is from a point in Baffin's Bay somewhat south of the rest. The material contained no Foraminifera worth recording; and therefore the locality was not included in the Table. The Radiolaria were few in number, and belonged to the genera *Spongodiscus* and *Spongotrochus*.

B. Off Cape Isabella, 220 fathoms, lat. 78° 20′ N.

Contained more than one species of *Spongotrochus*.

F. Between Walrus Shoal and Victoria Head, Sept. 8, 1876, 57 fathoms, lat. 79° 26′ N.

Five genera of Radiolaria represented, viz. *Haliomma*, *Tetrapyle*, *Heliodiscus*, *Spongaster*, and *Euchitonia*.

J and K. Dobbin Bay, 47 fathoms and 113 fathoms, lat. 79° 35′ N.

The only genera noticed were *Trematodiscus* and *Spongotrochus*.

X. Sounding, May 11, 1876, 72 fathoms, lat. 83° 19′ N.

The most northerly point attained. The little tube full of

mud which was secured yielded species of the following genera—*Dictyopodium*, *Haliomma*, *Tetrapyle*, *Heliodiscus*, *Actinomma*, *Spongotrochus*, *Spongaster*, and *Euchitonia*.

Thus in all there are ten genera of Radiolaria, eight of which exist in the highest latitudes that have yet been reached.

We are now in a position to inquire what actual service to biological science, or rather to that small section of it which has been considered in the foregoing pages, has been rendered by the North-Polar Expedition of 1875–76.

Nothing need be added to what has already been said about the Radiolaria. With respect to the Foraminifera it has been seen that previous researches had rendered account of the Arctic fauna as far north as lat. 76° 30′—that is, to within 13° 30′ of the North Pole. To this record we are now able to add three further instalments, namely, the group of soundings in Smith Sound and the north of Baffin's Bay, a single one in Hall Basin, and, lastly, a series to the north of Robeson Channel. These extend our knowledge of the sea-bottom to lat. 83° 19′ N., a distance of 6° 49′—in other words, over more than half the interval between the most northerly point of previous researches and the actual North Pole. From a zoological point of view the result is not less gratifying. Sir E. Parry's soundings in Baffin's Bay, which, taken together, furnish the northernmost section of Messrs. Parker and Jones's Table, yielded seventeen species of Foraminifera. All but three of these have been found in the material brought by Captain Feilden; but they form only a small part of the catalogue of fifty-three species which appear in our Table. Setting aside the Norwegian lists given by the same authors, as representing a fauna more or less influenced by the warm current of the Gulf-stream, the Hunde-Island and Baffin's-Bay columns give an aggregate of fifty-five species, or only two in excess of the total now recorded. The facts which have been elicited therefore appear to indicate that there is no very striking diminution in the number and variety of the Rhizopoda as we approach the North Pole.

EXPLANATION OF THE PLATES.

Plate XX.

Fig. 1. *Lituola glomerata*, n. sp., magnified 100 diam.: *a* and *b*, supero-lateral aspect, front and back; *c*, end view.

„ 2, *a*, *b*. *Hyperammina elongata*, n. gen. et sp., magn. 40 diam.

„ 3. *Lagena striatopunctata*, Parker & Jones, magn. 75 diam.

Fig. 4. *Lagena Feildeniana*, n. sp., magn. 75 diam.
Fig. 5. *Polymorphina acuminata*, D'Orbigny, magn. 75 diam.: *a*, periphero-lateral aspect; *b*, end view.
Fig. 6. *Polymorphina rotundata*, Bornemann, magn. 65 diam.: *a*, periphero-lateral aspect; *b*, end view.
Fig. 7. *Uvigerina pygmæa*, D'Orbigny, var., magn. 90 diam.
Fig. 8. *Textularia biformis*, Parker & Jones, magn. 90 diam.
Fig. 9. *Verneuilina polystropha*, Reuss, magn. 90 diam.

PLATE XXI.

Fig. 10. *Globigerina bulloides*, D'Orbigny, arctic variety, magn. 100 diam.: *a*, superior or spiral face; *b*, inferior aspect; *c*, peripheral aspect.
Fig. 11. *Pulvinulina Karsteni*, Reuss, magn. 50 diam.: *a*, superior; *b*, inferior; *c*, peripheral aspect.
Fig. 12. *Bulimina elegantissima*, D'Orbigny, var., magn. 90 diam.
Fig. 13. *Polystomella arctica*, Parker & Jones: *a*, lateral, *b*, peripheral aspect, magnified 30 diam.; *c*, horizontal section, showing the laminated thickening of the shell-wall and its minute tubulation, magn. 40 diam.; *d*, horizontal section of part of the outer convolution, more highly magnified, showing the bifurcation of the sutural orifices, magn. 100 diam.

L.—*Descriptions of new Species of Heterocera from Japan.*—Part III. *Geometrites.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

[Continued from p. 406.]

Zerenidæ.

ABRAXAS, Leach.

196. *Abraxas conspurcata*, n. sp.

Wings white, black at the base; black discocellular blotches, two parallel discal series of subconfluent black blotches, between which runs an orange line; a confluent series of marginal black blotches: primaries with the base orange-streaked; a central costal black patch confluent with the discocellular blotch; two subbasal black blotches. Body orange, spotted with black; the head and thorax black, but the back of the collar and tegulæ orange. Expanse 1 inch 7 lines.

Yokohama (*Jonas*).

This species is much like some extreme heavily spotted varieties of *A. grossulariata*; but it may be readily distinguished from them all by the two discal series of large spots or blotches being nearer to the outer margin and complete in the secondaries as well as in the primaries, also in the secondaries being broadly black at the base.

197. *Abraxas miranda*, n. sp.

Allied to *A. leopardinata* from India, but larger; the primaries with broader and darker basal and internal patches; the costa blotched with grey throughout, the patch over the end of the cell much larger and confluent with the costal patch; the transverse grey belt below it placed nearer to the middle of the wing and *touching the dark internal patch; two* confused parallel discal series of grey blotches; a number of small grey spots forming two imperfect parallel series on externo-discal area: the secondaries with a *complete* grey belt across the cell; two somewhat confused discal series of grey blotches terminating in the usual dark internal patch; external area spotted with grey; marginal blotches partially *confluent*. Body similar. Expanse, ♂ 2 inches, ♀ 2 inches 4 lines.

Yokohama (*Jonas*).

198. *Abraxas placida*, n. sp.

White, with ochraceous body; wings with ochreous outer border and black-spotted orange fringe; an externo-discal series of black spots, imperfect in secondaries; base ochraceous, spotted with black: primaries with three subbasal blackish spots; an irregular central band formed of blackish blotches; two black costal spots near apex: secondaries with a central irregular band formed of blackish lines: shoulders and palpi blackish. Wings below nearly as above. Expanse 1 inch 5 lines.

Hakodaté (*Whitely*).

EUCHERA, Hübner.

199. *Euchera Agnes*, n. sp.

Wings white, with broad smoky-grey outer border, crossed by a more or less confluent series of white or whitish lunules parallel to the outer margin: primaries sometimes with the lunules very indistinct; base and a subcostal streak ochreous; basal area covered by about ten grey spots in three series; a central broad belt, externally angulated, composed of grey blotches: secondaries with a grey belt almost surrounding the discoidal cell: body ochreous. Wings below white, the markings almost as above, but blackish and narrower; white lunules confluent and well-defined on all the wings, blackish discocellular spots: primaries only ochreous on the costal border, the basal area only marked with one large blackish

blotch: body below white; abdomen belted with grey. Expanse 2 inches 6–8 lines.

Yokohama (*Jonas*); Hakodaté (*Whitely*).

DEROCA, Walker.

200. *Deroca phasma*, n. sp.

♂. Hyaline, snow-white: primaries with three grey spots across the basal half of the costa, a fourth above the end of the cell, and a larger spot at the end of the cell; a large apical patch crossed by a trifid white patch, and a similar smaller patch at the external angle grey: antennæ with grey pectinations; abdomen grey, crossed by white segmental lines. Wings below nearly as above, but the grey markings darker and the costal spots on the basal half confluent; body below cream-coloured. Expanse 1 inch 4 lines.

♀. Larger, iridescent, and with much paler markings. Expanse 1 inch 6 lines.

Yokohama (*Jonas*).

LOMASPILIS, Hübner.

201. *Lomaspilis opis*, n. sp.

Wings creamy white: primaries with the basal fourth, three large blotches across the centre (the two uppermost confluent), the apex, outer margin, and external angle pale purplish brown: secondaries with three blotches across the centre, the apex, a subapical marginal spot, outer margin, and anal angle pale purplish brown. Body brown, legs testaceous. Expanse 1 inch 1 line.

Yokohama (*Jonas*).

Nearly allied to the European *L. marginata*, but differing in the brown blotches across the centre of the wings.

Ligiidæ.

PACHYLIGIA, n. gen.

Allied to *Ligia*, with similar antennæ and neuration; the body much more robust, broader; the primaries much wider, with more strongly defined external angle; fringe shorter. Type *P. dolosa*.

202. *Pachyligia dolosa*, n. sp.

Primaries fuliginous brown, varied with bronzy brown; base longitudinally streaked with black; two irregularly sinuated central black lines, and between them an irregular

blackish stripe; upper discocellular black; outer border bronzy, with undulated inner edge; a submarginal series of dark brown spots; margin undulated; fringe pale at base: secondaries sordid white, with pinky brown outer border and darker brown fringe; upper discocellular black: head and thorax brown; abdomen testaceous; antennæ testaceous. Primaries below greyish, with testaceous costa; outer border slightly paler; a black discocellular dot: secondaries whity brown, with testaceous costa; fringe and an anal streak dusky; a large black discocellular spot. Expanse 1 inch 11 lines.

Yokohama (*Jonas*).

203. *Pachyligia modesta*, n. sp.

♂. Primaries silvery whitish, crossed by two slender irregularly dentate and crinkled blackish lines; a third paler line limiting the outer border: secondaries slightly browner in tint than the primaries, crossed in the middle by an irregularly sinuated grey line; margin slenderly blackish; fringe silvery whitish: head and thorax grey; antennæ with brown pectinations; abdomen testaceous. Under surface pale whity brown: wings with the costal borders testaceous; each wing with a dentate-sinuate grey discal line and a blackish marginal line. Expanse 1 inch 9 lines.

Yokohama (*Jonas*).

The single female example obtained is darker than the male, the primaries being varied with bronzy brownish, and the area enclosed by the blackish lines distinctly grey; this example, however, is small and has the primaries so much narrower than other examples of this genus that I suspect it to be aborted.

Hyberniidæ.

HYBERNIA, Latreille.

204. *Hybernia dira*, n. sp.

General character of *H. leucophæaria*: primaries fuliginous brown, streaked here and there with tawny; a central irregular black-edged and speckled pale greyish belt, concave internally, unequally bisinuated externally; base greyish; outer border pale, bordered internally by an irregularly sinuated white line; a series of black marginal spots; fringe white, grey-speckled at base: secondaries pale greyish, speckled with grey, streaked with blackish on the abdominal area at anal angle; a black marginal line: body grey, black-spotted. Under surface greyish: wings with bronze-tinted borders and

blackish discocellular dots: secondaries speckled with grey. Expanse 1 inch 6 lines.

Yokohama (*Jonas*).

Most nearly allied to *H. obliquaria* of Motschoulsky.

Larentiidæ.

LARENTIA, Duponchel.

205. *Larentia Hemana*, n. sp.

Closely allied to *L. salicata*, but the central band of primaries of nearly twice the width, the wings altogether paler, and the secondaries similar in marking to *L. cæsiata*. Expanse 1 inch 2 lines.

Yokohama (*Jonas*).

Unless carefully compared with *L. salicata* of Europe, this species might easily be confounded with it.

EUPITHECIA, Curtis.

206. *Eupithecia sophia*, n. sp.

Allied to *E. denticulata* of Europe; sordid white with pale greyish outer borders and fringes to the wings, and black discocellular spots: primaries with the basal half of costa and the basal area blackish, crossed by irregular white lines; remainder of the wing crossed alternately by grey belts and white lines, the widest of which form an indistinct central oblique band; all the lines zigzag: secondaries crossed by one or two indistinct greyish lines. Wings below whiter, shining, the markings of the primaries only visible through the wings, excepting upon the costal border. Expanse 9 lines.

Yokohama (*Jonas*).

207. *Eupithecia invisa*, n. sp.

Pale silky greyish; external area of wings crossed by five slightly irregular parallel grey lines, most distinct on the primaries, the two inner lines dotted with black upon the nervures; discocellular spots black: primaries with the costa dusky, crossed by dark spots; a very ill-defined oblique belt across the centre of the wing, but scarcely darker than the ground-colour. Under surface whitish; the discal lines indicated by a series of dusky spots, two at costa of primaries blackish; discocellular spots black. Expanse 1 inch.

Hakodaté (*Whitely*).

This species is allied to the preceding; owing to its greyer tint it is much less like *E. denticulata*.

208. *Eupithecia excisa*, n. sp.

Nearly allied to *E. succenturiata* of Europe, but differing in its smaller size, greyer primaries, and in the front margin of the central belt of primaries being deeply and angularly notched beyond the discoidal cell. Expanse 11 lines.

Yokohama (*Jonas*).

209. *Eupithecia rufescens*, n. sp.

Apparently allied to *E. satyrata* of Europe, but much larger and with considerably longer palpi; an oblique subbasal belt and the external area of the primaries laky brown; a black marginal line enclosed in and interrupted upon the veins by a white line. Expanse 11 lines.

Yokohama (*Jonas*).

210. *Eupithecia proterva*, n. sp.

Allied to *E. innotata*, larger; the primaries still more produced, pale smoky grey: primaries with the base, a subbasal band, an oblique whitish-edged central belt (angular, excised above the median vein), and the external area blackish; a crinkled whitish submarginal line; discocellulars black: secondaries covered with parallel dusky lines, which become black upon the veins. Wings below grey; the discocellulars, two discal series of dots, and a marginal series black. Expanse 1 inch.

Yokohama (*Jonas*).

211. *Eupithecia caliginea*, n. sp.

Near to *E. pygmæata*, but the ground-colour of the wings black instead of sooty grey; the crinkled lines across the primaries formed of white scales. Expanse 10 lines.

Yokohama (*Jonas*).

This is the Japanese representative of *E. pygmæata*.

COLLIX, Guénée.

212. *Collix Vashti*, n. sp.

Dark fuliginous brown; the wings crossed by from eighteen to twenty parallel undulated blackish or black lines, more or less dotted with white upon the nervures; submarginal line indistinctly white-edged on the primaries; marginal line well-defined and black, the sinuations filled by white dots on the fringe: secondaries with all the lines less distinct than

on the primaries. Under surface sericeous, the blackish lines ill-defined. Expanse 1 inch 2–8 lines.

Hakodaté (*Whitely*).

Lobophora, Curtis.

213. *Lobophora julia*, n. sp.

Primaries above pale purplish brown, crossed by numerous irregularly crinkled or zigzag blackish lines; two pale green belts across the basal area, and a zigzag discal belt of the same colour, edged internally with white; a slender zigzag submarginal white line; a large black discocellular spot: secondaries pale shining grey, the disk crossed by several parallel slightly darker lines. Abdomen banded with testaceous. Wings below pale silvery grey, with black discocellular dots; a blackish macular discal line, and a zigzag pale grey submarginal line. Expanse 1 inch.

Yokohama (*Jonas*).

This species, excepting in its long palpi, somewhat resembles *Eupithecia togata*.

214. *Lobophora volitans*, n. sp.

♂ ♀. Wings white: primaries shining, more or less densely sprinkled with grey scales, and crossed by a basal and two central black-edged sap-green bands; a discal sinuated black-edged white stripe, more or less obscured by grey scales; outer border greenish, with a marginal series of black ⊢-shaped markings terminating the veins; the veins throughout black-banded: secondaries with a discal line and a sinuated submarginal line pale grey; a dark grey marginal line. Body grey, varied with brown, and spotted here and there with black; legs black, banded with white. Under surface sordid sericeous whitish: wings crossed by two greyish discal lines; blackish linear discocellular and marginal dots. Expanse 1 inch 2 lines.

Yokohama (*Jonas*).

Var. *elegans*.

♂. Primaries with the basal and central bands reddish brown instead of green; the outermost or discal band being more distinctly lunulated and white internally. Expanse 1 inch 2 lines.

Yokohama (*Jonas*).

215. *Lobophora terranea*, n. sp.

Similar in form to the preceding, but the wings smaller

and rather narrower, grey: the primaries crossed by three basal, two more or less confluent central belts, and one discal sinuated belt; basal and apical areas suffused with red-brown; central belts red-brown with blackish outlines; other belts outlined in blackish; veins banded with blackish; a series of marginal dots: secondaries with whitish costal area; a submarginal pale grey line. Under surface sericeous grey. Expanse 1 inch 2 lines.

Yokohama (*Jonas*).

Allied to *L. polycommata.*

LYGRANOA, n. gen.

Allied to *Lobophora*, but the primaries broader and more acuminate, the discoidal cell considerably shorter, the second and third median branches emitted much closer together, the upper radial emitted from the end of the cell instead of from the postdiscoidal cellule; antennæ strongly pectinate in the male. Type *L. fusca.*

216. *Lygranoa fusca*, n. sp.

Pale brown, wings with slender blackish marginal line, followed by a yellowish line at the base of the fringe: primaries with dusky base; an abbreviated black costal dash across the end of the cell, and a second halfway between the cell and apex; two irregular subparallel brown lines running from the costal dashes across the wing to inner margin; a subapical black costal spot; fringe whitish, intersected by a grey stripe. Wings below sericeous whity brown; discocellular dots and a discal series grey: primaries with bronzy borders; fringe as above, but more decidedly grey-spotted at the ends of the veins. Expanse 11 lines to 1 inch 2 lines.

Yokohama (*Jonas*); Hakodaté (*Whitely*).

MELANTHIA, Duponchel.

217. *Melanthia casta*, n. sp.

Nearly allied to *M. albicillata*, but larger; the markings more sharply defined and blackish; the macular subapical portion of the interrupted discal stripe bifid, not trifid, and therefore not united to the large costal patch; discocellular spots black and well defined. Wings below with darker markings; the macular discal stripe well defined in the secondaries as well as the primaries. Expanse 1 inch 6 lines.

Hakodaté (*Whitely*).

MELANIPPE, Duponchel.

218. *Melanippe inquinata*, n. sp.

Closely allied to *M. procellata* of Europe, but larger; the wings always more or less suffused with grey, sometimes only enough to make them look sordid, sometimes so dark as almost to conceal the ordinary markings: primaries with the basal dark patch broader, and the dark outer border of twice the width. Expanse 1 inch 7 lines.

Yokohama (*Jonas*); Hakodaté (*Whitely*).

219. *Melanippe bella*, n. sp.

Allied to the preceding, but with unusually small secondaries: wings white, suffused, excepting at the borders, with stramineous; the apical and external or anal borders blotched with red-brown and bounded internally by a discal series of blackish rounded spots, interrupted on each wing upon the second median interspace; black discocellular spots: primaries with the costal border spotted with red-brown and grey, most broadly above the end of the cell; a tawny spot near the base of inner margin; two or three very indistinct slender brownish lines across the wing, the outermost one zigzag: secondaries with a grey basal stripe, a central grey elbowed belt, and an arched grey stripe just beyond the middle: body white, head sordid, antennæ black. Wings below with all the markings black or grey; a central belt followed by a grey streak on all the wings; basal area of primaries greyish: body grey, whitish in front; legs varied above with black and white. Expanse 1 inch 4–6 lines.

Yokohama (*Jonas*); Hakodaté (*Whitely*).

220. *Melanippe supergressa*, n. sp.

Closely allied to *M. rivata* of Europe, the markings blacker, the discal white belt beyond the central band broader; the base of secondaries white, irrorated with grey, but not densely; three central parallel dark grey lines not reaching the costa: wings below with the markings better defined. Expanse 1 inch 1 line.

Hakodaté (*Whitely*); Yokohama (*Jonas*).

The whiter base to the secondaries and blacker bands are the best characters for distinguishing this species from its European congener.

221. *Melanippe hecate*, n. sp.

Black, mottled indistinctly with grey: wings with the fringes spotted with white; a broad irregular white band just

beyond the middle, strongly angulated on the primaries; these wings also with a double submarginal series of pale spots; the inner series with one upon the costa, and a second just beyond the angle of the irregular band, white: back of head white, antennæ dotted with white, abdomen with white margins to the segments. Wings below greyer than above, the basal area crossed by parallel transverse whitish streaks; body white. Expanse 1 inch 4 lines.

Yokohama (*Jonas*).

Allied to *M. furcifascia*, but the white band broader, more strongly angulated on the primaries, and continued through the secondaries.

ANTICLEA, Stephens.

222. *Anticlea consanguinea*, n. sp.

Nearly allied to *A. berberata* of Europe, but of a more uniformly grey colour: primaries with the bands broader, the subbasal band more regular, the dark band just before the middle of the wing distinctly angulated above the median vein; the discal band less strongly dentated; outer border broadly dusky, completely obliterating the sinuated submarginal lines: secondaries greyish brown, crossed beyond the middle by an angulated and sinuated dusky line. Wings below similar in colouring to those of *A. berberata*, but with a strongly defined continuous discal line. Expanse 1 inch 2 lines.

Hakodaté (*Whitely*).

COREMIA, Guénée.

223. *Coremia livida*, n. sp.

Allied to *C. ferrugata*, but uniformly greyish brown; the basal bands more decidedly undulated, and only indicated in outline by dark lines; the broad dark belt further from the base, its margins more decidedly undulated, its inner margin more irregular, its outer margin less decidedly angulated; outer border smoky grey, bounded by a continuous series of white-edged dark lunules, those spots which are dark in *C. ferrugata* being only slightly darker than the others; the zigzag discal line of the European species replaced by a sinuated line forming an internal boundary to the submarginal lunules; lines across the secondaries less strongly defined: wings below more uniform in tint and sericeous grey, with the sinuated parallel lines arched rather than angulated. Expanse 1 inch 1 line.

Yokohama (*Jonas*).

224. *Coremia frigida*, n. sp.

White, the primaries spotted at the base with black and smoky brown; two central angulated black lines, indicating the usual band, the outer one diffused internally above the middle; a black spot at the end of the cell; outer border smoky brown, margined and traversed internally by two black lines parallel to the outer of the two central lines; veins upon the border black, each with a central white dot, the whole together forming a submarginal series; fringe white-spotted: secondaries silver-grey, with the external area regularly white; a marginal series of dark grey spots which run through the fringe; a blackish discocellular spot: body whitish, greyish in front, dotted with black; antennæ black annulated with white. Primaries below with the basal two thirds silver-grey, crossed near the base by two grey stripes visible only from the transparence of the wing, the inner one marked with two blackish spots; an oblique black fasciole across the end of the cell, partly limiting the grey area; an angulated white discal belt, followed by a black border; a white subapical costal dot, and a series on the fringe: secondaries as above: body below white. Expanse 1 inch.

Yokohama (*Jonas*).

A beautiful little species, in pattern most nearly resembling "*Coremia*" *heliacaria*; the latter, however, has strongly pectinate antennæ in the male.

CIDARIA, Treitschke.

225. *Cidaria melancholica*, n. sp.

Allied to *C. silaceata*, but considerably larger, the white line nearest to the base of primaries more regular, not succeeded by a yellow line; the line which follows it (indicating the inner edge of the central band) acutely angulated upon the median vein; the lines and veins on the external area, which are yellow in *C. silaceata*, pale testaceous or sordid whitish; a small blue-pupilled ocellus beyond the discoidal cell; secondaries smoky grey throughout, with the usual sinuated white-edged discal lines. Expanse 1 inch 10 lines.

Yokohama (*Jonas*).

Typical *C. silaceata* seems to be common in Japan.

226. *Cidaria obscura*, n. sp.

Most like very dark varieties of *C. russata*, but altogether darker and with a different pattern on the underside. Greyish brown, the primaries with a pink tinge, markings extremely

like those of *C. russata*, dark brown, limited by pale-bordered black lines; a slightly sinuated black outer margin and grey-tipped fringe: secondaries with dusky external border, on which there is an indication of a paler submarginal sinuated line; a black scalloped marginal line; fringe grey, with pale basal line. Wings below grey, with pale testaceous costal borders; dusky discocellular dots; three parallel darker grey postmedian lines, followed by a whity-brown broadly sinuated discal belt; a submarginal dusky belt followed by an ill-defined undulated pale line; outer border grey; fringe whity brown: body whity brown. Expanse 1 inch 5 lines.

Yokohama (*Jonas*).

C. russata is common in Japan.

227. *Cidaria ærosa*, n. sp.

Closely allied to *C. reticulata*, but nearly twice as large and with all the lines of primaries brassy yellow instead of white; secondaries and body tinted with brassy yellow; under surface pale brassy yellow, with indistinct greyish markings similar to those of *C. reticulata*. Expanse 1 inch 9 lines.

Hakodaté (*Whitely*).

228. *Cidaria tetrica*, n. sp.

Nearest to *C. suffumata*, but considerably larger; the primaries mottled all over with olivaceous, with diffused bronzy borders to the veins; the markings may be thus described:—Wings dark brown, crossed by three silvery bands, all of which are forked, the first two from the median vein, the third from the upper radial or inferior subcostal branch; central band twice as wide as the others; between each two bands and between the external band and outer margin a slender silvery more or less sinuated line; a marginal series of silvery spots with black centres: secondaries white, speckled with grey; two parallel discal grey lines, on the outer one several blackish spots; a marginal series of blackish spots; fringe yellowish: body brown, banded with pale yellow and white. Under surface shining white: primaries mottled with grey; costa speckled with black: secondaries speckled with brown and grey; a brown discocellular spot and a brown angulated discal line; a grey interrupted submarginal line. Expanse 1 inch 8 lines.

Yokohama (*Jonas*).

229. *Cidaria cineraria*, n. sp.

Very closely allied to *C. picata*, but the markings blacker;

the central band of primaries not notched at the second median branch; all the yellow or yellowish olivaceous markings replaced by ashy grey: the white belt of secondaries wider, the body darker. Expanse 1 inch 4 lines.

Hakodaté (*Whitely*).

230. *Cidaria jameza*, n. sp.

Allied to *C. inspurcata*: primaries sepia-brown, crossed near the base by two irregular white lines, undulated and angulated above the median vein; two black-edged very irregular dentate-sinuate white discal lines, only separated by a brown centre line; a dentate-sinuate white submarginal line; centre of external area sprinkled with white scales; a black-spotted white marginal line; fringe spotted with whitish: secondaries grey; costal area, an angulated chain-like postmedian belt, a dentate-sinuate submarginal line and the margin white; a marginal series of black spots; fringe as in primaries: thorax brown, abdomen grey. Wings below with the basal area uniformly grey, limited externally by the discal line, which is represented by subconfluent black spots; discocellulars black. Expanse 1 inch 3 lines.

Hakodaté (*Whitely*).

Euboliidæ.

Eubolia, Duponchel.

231. *Eubolia niphonica*, n. sp.

Primaries with the basal two thirds smoky brown, blackish externally, and limited by an irregular bracket-shaped whitish line; external third paler white towards the border; two irregular arched whitish-edged black lines near the base; a black spot at the end of the cell; three or four subapical white dots; two black subapical spots: secondaries pale smoky brown, with a central whitish-edged dusky bracket-shaped line; outer margin white, dotted with black: thorax blackish, abdomen brown: under surface paler, the basal lines obsolete, the veins on the disk with reddish borders; black discocellular spots well-defined. Expanse 1 inch 6 lines.

Yokohama (*Jonas*).

Allied to *E. mæniaria*.

LI.—*Notes on the Internal and External Structure of Palæozoic Crinoids.* By CHARLES WACHSMUTH*.

[Continued from p. 392.]

5. *The Construction of the Summit, and its Value in Classification.*

The construction of the ventral disk or actinal side of the calyx has heretofore received less attention than almost any other part of the Crinoids; and thereby an important aid to classification has been overlooked. I think it affords a clear and most important distinction between recent and ancient Crinoids, and shows that they fall naturally into two great divisions or groups. This view, although it does not agree with the opinion of other authors, who, in their classifications, have placed a number of Palæozoic genera in the same group with the recent Crinoids, is, as I hope to show, well founded.

Dr. F. Roemer, in the 'Lethæa Geognostica,' 1855, p. 227, divides "*the true Crinoids*, which are supported by an articulated or jointed column," into two divisions:—

a. Crinoids in which *the ventral side consists of a soft skin.*

b. Those in which *the ventral side is covered by solid immovable plates.*

Roemer includes with the former group Pentacrinidæ, Apiocrinidæ, Eugeniacrinidæ, Encrinidæ, Cupressocrinidæ, and Cyathocrinidæ. This division seems to have been based on mere conjecture, since a membranous ventral surface has been observed only in the Pentacrinidæ and the recent Crinoids generally, though it is probable that *Eugeniacrinus* and several allied genera had that summit structure. In the Apiocrinidæ and Encrinidæ, however, the general construction of the dorsal or abactinal parts, the massive plates, both of calyx and arms, indicate rather a closer relationship with the ancient Crinoids, and suggest the existence of a solid dome. The latter becomes more probable since a solid vault has been discovered in *Belemnocrinus.* This genus is in its generic formula and general form almost identical with the recent *Rhizocrinus*, which, on the contrary, is covered by a soft peristome. Both are closely related to *Apiocrinus*; *Belemnocrinus* particularly has the same heavy body-plates and the small visceral cavity; and it appears to me that *Apiocrinus* is more nearly allied to the Palæozoic type than to the recent *Rhizocrinus.*

The Cupressocrinidæ and Cyathocrinidæ are the only groups from Palæozoic formations which Roemer places in his divi-

* From 'Silliman's American Journal,' Sept. 1877.

sion *a*. Dr. Schultze, who adopted Roemer's classification, included in the Cupressocrinidæ the genera "*Synbathocrinus*, Phill., and *Phimocrinus*, L. Schl.," in which he is undoubtedly correct, for stronger reasons even than he himself perceived. These two genera agree with *Cupressocrinus* not only in the simplicity of their arms, but also in the so-called "consolidating apparatus," which he describes and figures in the latter. The apparatus is placed horizontally in *Cupressocrinus*, upright and turbinate in the two other genera. When the consolidating plates in *Synbathocrinus* are preserved, the ventral side appears to have two separate apertures, a lateral proboscis and a central mouth. And so the genus was originally described. This, however, is a misconception. By removing carefully all the arm-joints from a specimen of *Synbathocrinus*, I discovered the central aperture perfectly covered with a number of small plates; and to this summit, as it might be called, were attached narrow lateral extensions, composed of alternating pieces, which, passing downward, covered the little grooves that lead to the arm-furrows. The consolidating apparatus here forms, in fact, a part of the solid vault. It is reasonable to conclude that in the allied genera *Cupressocrinus* and *Phimocrinus*, so closely related to *Synbathocrinus* otherwise, the central opening was closed, and that the consolidating plates were further overlaid with plates forming the floor of a passage in connexion with the arm-furrows and visceral cavity. The small plates which extend out to the arms are in the specimen but partly preserved, and the connexion with the arm-furrow is interrupted; but there can be no doubt that the channel underneath contained the food-groove and ambulacral canal which I have described in *Cyathocrinus*. The covering of the central opening of *Synbathocrinus* resembles in a remarkable degree that of the central aperture of the Blastoids; and it seems to me highly probable that the consolidating plates are homologous with the partly hidden deltoid pieces of the latter.

Among the Cyathocrinidæ Roemer included genera of widely different types. Besides the typical one, he enumerates nine genera, only two of which, *Heterocrinus* and *Graphiocrinus*, have the characteristics of the Cyathocrinidæ; and both of them evidently possess a solid dome, as is proved by their heavy proboscis. All the remaining genera belong to other groups. *Macrostylocrinus* resembles *Ctenocrinus*, Bronn, and *Cytocrinus*, Roemer, so closely, that they may yet prove to be identical. Roemer, however, places *Ctenocrinus* with *Glyptocrinus* among the Crinoids with a solid dome, and *Macrostylocrinus* among the Cyathocrinidæ. *Macrostylocri-*

nus is allied to *Melocrinus*, and has undoubtedly a similar summit-structure. The same may be said of *Schizocrinus* and *Dimerocrinus*, which are not at all related to *Cyathocrinus.*

The genus *Cyathocrinus* was originally described by Prof. Phillips and Mr. Austin as having a separate mouth and vent, which was considered by these authors and others to be its chief distinction from *Poteriocrinus.* Accordingly, all species with a proboscis or solid dome, though otherwise agreeing with *Cyathocrinus*, were referred to *Poteriocrinus* or some allied genus. Meek and Worthen, however, proved (in the Geological Report of Illinois, vol. v. p. 325) that in perfect specimens the central opening is closed. The covering of *Cyathocrinus* is exceedingly interesting, and throws light upon the summit-structure of many genera. I shall herein refer frequently to Meek and Worthen's excellent figures, vol. v. pl. ix. figs. 13, 14.

Looking only at fig. 14, one would at first naturally suppose there must have been, during the life of the animal, two distinct openings in the vault. But on examining it more critically, and comparing it with fig. 13, it will be found that fig. 14 represents simply the consolidating apparatus as figured by Roemer and Schultze in *Cupressocrinus*, placed here exactly as in that genus, and consisting of five large pieces, alternating with the upper edges of the first radial plates. The plate of the anal side is larger than the others, and forms the base of the inner side of the proboscis. The five pieces, which connect with each other laterally, extend inward for some distance, but not so far as to meet in the centre, where there is a semicircular or heart-shaped opening. Along the sutures between the five plates a comparatively large furrow from each arm-base extends inward, and leads to the central opening. Examining now fig. 13 we find the general aspect of the ventral disk entirely changed. The lateral opening has been transformed into the base of a proboscis; and the consolidating plates are partly covered, leaving but a small uncovered space, in the form of a delta, in the interradial areas. The central opening is vaulted over by a number of various-sized pieces, the largest one occupying the side towards the proboscis. The shallow groove between the sutures of the consolidating plates is arched by a double series of alternating plates, forming underneath a passage for the ambulacral canal and food-groove. The vault, thus closely resembling that of *Synbathocrinus*, was in all probability arranged on a similar principle in *Cupressocrinus.* The same plan, with slight modifications, prevailed in *Poteriocrinus*,

Scaphiocrinus, and all genera with an *inflated* or *balloon-shaped ventral sac*. Among the latter the centre of radiation is frequently found to be pushed toward the anterior side, so that, owing to the great size of the sac at its junction with the dorsal cup, it does not occupy the centre of figure.

Among all groups of Crinoids, the Cyathocrinidæ undergo the least amount of change in the course of time. They are represented in the Lower Silurian by several genera; and *Cyathocrinus* is the only genus recognized in the Permian. In all intermediate formations we find Crinoids with five basals, five subradials, and five radials; and it is worthy of note that the Cyathocrinidæ, in the structure of their vault, bear closer resemblance to the recent Crinoids than almost any other group, and seem to hold an intermediate position between modern and Palæozoic types. If the alternating plates covering the furrows could be turned back at the vault by the animal as the Saumplatten of the arms, then the food-groove of these Crinoids was open throughout, as in recent forms. This might possibly have been the case in *Cyathocrinus iowensis*; but I even doubt it here, as the corresponding plates in other closely related species, though arranged upon the same fundamental plan, present rather an aspect of true vault pieces. The Cupressocrinidæ and Cyathocrinidæ thus fall naturally into a group by themselves, having the vault supported by consolidating plates, and covered by an immovable arch of small plates.

The next group, including *Taxocrinus*, *Forbesiocrinus*, *Onychocrinus*, *Ichthyocrinus*, *Lecanocrinus*, and probably other genera, is one in which, of all Palæozoic Crinoids, the vault is least known. The Taxocrinidæ (for such I will call them) have hitherto been described as being covered with some soft material instead of solid plates, even by Dr. Schultze, though he describes and figures a *Taxocrinus* with a long, heavy, plated proboscis, which could not have been supported upon a soft skin*. In this group the plates of the radial series are indented on their upper margins more or less deeply for the reception of a protuberance from the lower side of the succeeding plate. The indentation of the upper margin does not extend throughout the thickness of the plate; and in *Forbesiocrinus* it is filled by a superficial patelloid plate, which is

* I believe Dr. Schultze is mistaken in referring his *T. briareus* to *Taxocrinus*, as it lacks all the characteristic features of the genus. Its rather large subradials, the large first radials as compared with the succeeding radials, the single anal plate upon which the heavy proboscis rests, indicate that it belongs to *Cyathocrinus* or some allied genus. His *T. gracilis* may prove to be *Graphiocrinus* or *Scaphiocrinus* (?).

separately articulated and sometimes ankylosed with the outer margin of the plate above. This peculiarity not only exists in the arm-plates, but is conspicuous in the radials, thus producing apparently an articulate structure of the whole skeleton and indicating some degree of flexibility in the body as well as the arms. The interradial portions appear sometimes depressed, and in other cases swollen or bulged out, showing that they probably yielded to a moderate expansion or contraction of the body-walls, due to the mobility of the radial parts, which likewise involves a flexibility of the summit. I have not been so fortunate to find the summit of any of these genera perfectly preserved; but I feel convinced from what I have observed that it did not consist of a soft skin. In *Onychocrinus*, the genus which possessed evidently the greatest expansive power, the radial plates are frequently found spread out horizontally, and I have found towards the inner or ventral side of the radials rather large imbricating plates, to which smaller ones are attached which connect with the plates of the interradial series, and which decrease in thickness inwardly. In several specimens I found the inner part or centre of the disk covered by a number of thin, very small plates, whose arrangement could not be made out; but it is highly probable, from their size and shape, that they formed a kind of scaly integument which was pliant and flexible, thus facilitating a contraction or expansion of the dorsal portions.

The close relationship existing between *Onychocrinus*, *Forbesiocrinus*, and *Taxocrinus* renders it almost certain that their summit was similarly constructed. In *Ichthyocrinus* the peculiarities in the radial portions are less strongly marked, and the genus has no interradial plate; but as it agrees otherwise so nearly with *Taxocrinus* that it is sometimes difficult to separate them, we may feel sure that this Silurian genus forms no exception to the general rule, but that its mouth was covered as in other Palæozoic Crinoids.

That the summit in several genera has not been discovered is no proof that it consisted of soft material. During the eighteen years that I collected at Burlington I obtained several hundred of the most perfect specimens of *Cyathocrinus*, some of them as perfect in most of their parts as if dredged from the ocean; but only two specimens have been discovered in which the summit was preserved, and only a single *Scaphiocrinus*. That this could happen at a locality where even the finest tissues of the most delicate internal organs are preserved, is somewhat astonishing; but yet it can be accounted for by the fact that the pieces which cover the central opening, as also the small alternating plates forming the ambulacral canal,

are very thin, and that they rest but partly upon the consolidating plates, being thereby rendered insecure and liable to removal by any accident, even with very small force. Moreover the arms of the Cyathocrinidæ are generally attached, and the ventral disk thus hidden from view. In specimens in which the arms are destroyed their destruction almost invariably involved that of the entire ventral side; and so delicate are these parts, that even when the arms are well preserved and so situated as to expose the dome, the plates are nearly always gone, or are found in a confused mass inside the calyx.

I come now to another group, in which, on the basis of the summit-structure, such apparently diverse forms are included that I am under the necessity, very unwillingly, of making a name for it. It includes the families Actinocrinidæ, Platycrinidæ, Rhodocrinidæ, Melocrinidæ, and the genera *Schizocrinus*, *Dimerocrinus*, and *Macrostylocrinus*, which Roemer has ranged among the Cyathocrinidæ; and I call it provisionally the Sphæroidæ, from the form of the calyx, which is generally somewhat spherical. This large group, embracing over one hundred genera, and ranging from the base of the Silurian to the top of the Subcarboniferous, is capable of accurate definition, is easily distinguished, and, fortunately, the summit is very commonly found well preserved in most of the genera.

The summit is composed of heavy, frequently nodose plates, closely cemented together so as to form a *free arch* (not supported by consolidating plates), which rests like a hemisphere upon the dorsal cup. The plates of the summit, which at first sight exhibit great apparent diversity, are arranged throughout upon one and the same fundamental plan. Beginning with genera that have but few vault-pieces, we find in them the median portion occupied by one large centre plate, surrounded by six others—four large ones of equal size, and two smaller ones. The four large plates join laterally, and are often placed directly to the centre piece. In very large species and sometimes in very old specimens the plates are separated by small polygonal pieces, but easily recognized by their size. Two of the four plates lie above the interradial series adjoining the anterior ray; the two others, one at each side, are placed between the two lateral rays. The two smaller plates are separated from each other by anal plates or by the proboscis. These seven pieces, which I will call the "*apical plates*," are easily recognized by their greater prominence and size in species with comparatively few summit-plates and a lateral anal aperture; but their identification is more difficult in

species in which a subcentral proboscis is placed between the two small plates, and the whole vault looks like an immense proboscis. In these forms the four large plates, together with the two smaller ones, are pushed towards the anterior side of the specimen, while the centre plate rests with one side against the proboscis.

There are other summit-plates following a radial direction, which are either attached to the apical pieces or separated from them by a belt of small polygonal plates. Their number, which varies greatly in different species, depends upon the number of primary arms that spring out directly from the body, no matter how often the arms branch afterward. In species with only two arms to the ray, each ray has two rows of corresponding plates in the dome: one large bifurcating plate forms the upper row, three plates the second row; two of the latter are brachial plates, the third one is an interbrachial plate separating the two arms. In rays with three arms, there are eight plates in three series. The upper series consists of one large bifurcating plate, which evidently corresponds with the third radial of the dorsal side. The second series, corresponding to the secondary radials, is composed of two plates, the plate towards the division with two arms being as large as the plate of the upper series, and the one towards the single arm much smaller. The third series is formed by three brachial and two interbrachial plates. In species with four arms to the ray, both radial pieces of the second series are large, and from each of them there originate two brachial pieces. As a general rule the summit-plates increase in proportion to the number of primary arms of a species in the same manner and on the same principle as the plates of the dorsal side. Every radial from the third radial upward has a corresponding plate on the ventral side, and additional interbrachial plates between corresponding brachial plates above the arms. Therefore in adult specimens, with some little practice, the number of arms can be ascertained nearly as well from the dome as from the dorsal side. The number of vault-pieces is enormous in some genera, especially if the radials branch off alternately, as, for instance, in *Strotocrinus*, where some species have 120 to 180 arms. In looking at a full-grown specimen, with its many hundred apparently irregularly arranged vault-pieces, one would scarcely expect to be able to discover that this construction, in nearly all the Palæozoic Crinoids, is based upon a definite plan, and that plan the same as prevails below the arms. That this is the case may be successfully demonstrated in the *young Strotocrinus*, which has comparatively fewer summit-plates.

The young specimen, in genera with numerous arms, has fewer arm-openings than the adult, though both have the same number of arms. This is best observed in the young *Strotocrinus*. Here the basals, primary radials, first anal, and first interradial pieces are comparatively large, while the higher series of interradials are yet absent or but slightly developed. The radials of the higher orders, which in adult specimens form a part of the body, are in young specimens free arm plates, unsupported by any interradial or interaxillary pieces. The arms, therefore, which spring directly from the body in adult specimens, in the young branch alternately right and left after emerging from the body, the spaces between the bases of the branches being subsequently filled by the upward growth of the body, so that the branching, instead of occurring in the free arms, seems to be completed in the body-walls. So, for instance, the young *Strotocrinus umbrosus* has at first but four arm-openings to the ray; at a later period it is found to have eight, and in the adult state twelve, being a separate opening for each arm*.

The rule that the number of summit-plates increases in proportion to the number of primary arms holds good with reference to the young specimen. The young *Strotocrinus* has fewer plates than the adult individual (the difference being in proportion to the state of growth); and these are arranged in the same order, and are as easily recognized, as those of the simplest species of this group. The apical and principal radial pieces are larger than the intervening interradial plates, which, exceptionally in this genus, attain by age the same size as the apical and radial pieces. *The interradial plates* of the vault occupy the intermediate spaces between the radial areas. As their number depends greatly upon the age of the individual, they vary often in the same species. In species with but few arms, we find comparatively few interradials, and those are generally smaller than the other plates. The latter is especially true in young specimens, as also in small species. Sometimes (as, for instance, in some *Megistocrini* and all Rhodocrinidæ) the greater part of the summit is covered by large numbers of small polygonal plates which form regular belts

* A young *Strotocrinus*, unless the arms are attached, cannot be distinguished generically from an adult *Actinocrinus proboscidialis*; and as both have the same peculiar ornamentation with the same number of arm-openings, they differ but slightly in specific characters. *Actinocrinus proboscidialis* is the typical species of a small group of beautifully ornamented Crinoids, and it is evidently the forefather of all *Strotocrini*, which idea seems to be further confirmed by the geological succession. The former group occurs only in the *Lower*, and *Strotocrinus* only in the *Upper* Burlington Limestone.

around the apical and radial plates. The species of these genera, though comparatively of large size, have generally but two primary arms, and consequently for each ray but one radial dome-plate, which is here placed at some distance from the arm-bases. In the *adult Megistocrinus* the radial as well as apical plates are extremely large, and stand forth conspicuously, and each one separately, among the surrounding minute polygonal pieces. In the *young Megistocrinus*, however, and in the Rhodocrinidæ generally, the apical pieces and the radial plate are placed side by side, being surrounded by the polygonal plates. The form and size of the principal summit-plates, the distribution and number of the interradial pieces, afford most excellent characters for distinguishing many genera. In *Agaricocrinus* all apical and radial pieces are large and tuberculous, the few interradials are small. In *Dorycrinus* the centre plate and first radials are spiniferous or nodose. In *Amphoracrinus* the four large apical pieces are spiniferous or tuberculous, the radials nodose. In *Platycrinus* and *Hexacrinus* the apical plates are very prominent, often tuberculous, the radial portions are somewhat constructed like the rows of small alternating plates of the Cyathocrinidæ. In *Batocrinus* all summit-plates are nodose and almost of equal size.

The apical plates can be distinguished in other groups as well as in this. They surmount the vault of *Synbathocrinus* and *Cyathocrinus*, cover the central opening of the Blastoids, and can be traced in many of the Cystideans. This, with the further fact that they are so largely developed in young specimens, that they cover and protect some of the most important organs of the inner cavity, shows their great importance, and leads us to infer that they were the first solid parts developed on the ventral side in young Crinoids. The centre piece corresponds evidently with the basals of the dorsal side, the surrounding plates to the subradials (the two smaller plates separated by the anus forming together one large one), which, on the other hand, were undoubtedly the first-developed parts of the dorsal side, and the parts which are the most highly developed in the Cystideans.

The above groups, representing the three principal plans upon which the vault is constructed, embrace, according to my views, not only all those Palæozoic genera which were supposed to be covered by a membranous surface, but nearly all Palæozoic Crinoids that are known. There are some few genera, as, for instance, *Eucalyptocrinus*, with a very peculiar superstructure at the ventral side, whose affinities I have not been able to determine. There is the genus *Calceocrinus*,

which differs so widely from all other known Crinoids by its distinct bilateral symmetry and unique structure that it forms evidently a very distinct group by itself. There may be still others, differing in their summit-structure from the general plan; but I have yet to discover a single Palæozoic genus in which a special oral aperture has been identified, or in which the existence of a solid vault has been disproved or cannot be traced by analogy. Thus it may be possible that the solid vault was essential under the conditions which prevailed in the earlier geological ages.

Closely related as the recent Crinoids are to their Palæozoic ancestors in some points, the solid vault of the latter cannot in the remotest degree be homologized with the soft peristôme of the former. The solid dome forms, as I think I have proved, a continuation of the radial and interradial series of the dorsal side, and serves merely as a covering and protection for the organs underneath. It is in every sense of the word aboral, and forms a part of the abactinal system, which, being already reduced in the Pentacrinidæ and Comatulidæ to a narrow tentacle-furrow, recedes in the Palæozoic Crinoids one step further, and disappears within the solid walls of the body. The actinal system here consists externally only of the arm-furrows, whence it continues underneath the vault. These Crinoids, therefore, are evidently of lower development and belong to an inferior type.

The ventral peristome of the recent Crinoids serves as a madreporic apparatus, introducing the necessary water for respiration. It is capable of expansion, and does expand when water or food is introduced into the inner cavity, and contracts when refuse matter is expelled. These are functions which the solid vault could not have performed; and there must have been, consequently, important modifications in the internal economy of these animals. Comparing the large size of the calyx of the *earlier* Crinoids with the small cup and large long arms of the *recent* types, we find in the former an approach to the *Cystideans*, as also a striking resemblance to the nascent *Pentacrinus* before its arms are fully developed. In the older forms, the radial plan is almost overshadowed by the bilateral arrangement of the vault, which reminds of the bilateral symmetry in the earlier stages of other Echinoderms. All these facts tend to prove that the *Palæozoic Crinoids*, embracing therein all *true Crinoids in which the actinal side is closed*, represent the young stage of growth of the living types. They bear evidently the same relation to the Pentacrinidæ and Comatulidæ as the Perischoechinidæ *bear to the* Echini, *as the Cystideæ and Blastoideæ bear to the Palæozoic*

Crinoids. They unquestionably form a *distinct group* of Crinoids; and I therefore propose for it, from the fact that its representatives lived almost exclusively in Palæozoic times, the name "*Palæocrinoidea,*" *as a suborder of the Crinoids.*

Whether *Encrinus*, *Apiocrinus*, and allied genera of the Jurassic time are to be brought within this suborder, depends upon the construction of their vault, which cannot at present be determined. Should they prove to have a solid dome, they would be included here; and this might detract slightly from the technical exactness of the name *Palæocrinoidea.* Still, as its characteristic types were so prevalent, and constituted so important a part of the life of Palæozoic ages, and the Mesozoic forms are comparatively so insignificant in variety and abundance, the term would nevertheless be significant and appropriate.

I shall not attempt to separate the Palæocrinoidea into families, as I think our present knowledge is hardly sufficient for such a work; but I feel convinced that it must be based mainly upon the diversities in the structure of the vault, not upon the construction of the dorsal cup, nor upon the structure of the arms or column, upon which former authors have founded such divisions.

The discoveries which have been made within the last few years, both in recent and extinct Crinoids, are really wonderful, and lead us to expect large additions to our knowledge in the future. I observe, in the February number of the 'American Journal,' that Prof. Thomson has discovered at great depth two new genera of Apiocrinidæ, one of them resembling in superficial structure the genus *Poteriocrinus.* This may throw new light upon the physiology of the extinct types and solve some of the questions herein suggested. Other discoveries will follow. The labours of the zoologist will supplement the researches of the palæontologist; and through their properly united efforts we may hope in time to comprehend the structure of the Palæocrinoidea almost as perfectly as if they were yet living in our oceans.

LII.—*Description of a remarkable new Form of* Ophiuridæ *from Ceylon.* By EDGAR A. SMITH, F.Z.S.

THE specimen about to be described was presented to the British Museum in 1875 by Mr. E. W. H. Holdsworth, by whom it was collected at Ceylon.

Apparently it is closely related to the genus *Ophiothela* of

Verrill, although, in relation to the hitherto described species of that genus, it is a giant. It differs only in the fewness of hooks or prongs with which the arm-spines of all the species are provided; and the upper surface of the disk and arms displays a much finer granulation.

This species also shows some affinity with *Ophiogymna* of Ljungman, judging from the brief and insufficient description of that author. The armature of the mouth is similar, the oral and adoral shields have the same position, and neither exhibit a tentacle-scale; but the radial shields in *Ophiogymna* are almost entirely covered with the soft skin enveloping the disk, whereas in the present species they are altogether naked as in *Ophiothela*. The arms are said to be very long by Ljungman; but his description does not inform us regarding the plates, whether they are naked or covered with skin, smooth or granulated. *Ophiocnemis* of Müller and Troschel agrees with this species in the parts of the mouth, but differs in the arms, arm-spines, and covering of the disk.

Ophiothela Holdsworthii, sp. nov.

Disk circular, moderately thick, clothed with a soft skin beneath and above, except on the large radial shields; the latter are very remarkable on account of a raised keel or ridge, which extends from the inner or narrow end of the shield almost to the outer extremity, where it is most elevated, and terminates in a prominent angle; the shields are large, elongate, subtriangular, adjacent along the inner margins, except at the end, where they are slightly separated, leaving a notch between for the origin or insertion of the arm; they do not reach quite to the centre of the disk; and the inter-radial naked space between the different pairs is about equal in extent to one of the shields. *Oral shields* indistinct, small, somewhat triangular, with an angle towards the mouth between the small irregularly oval adoral scuta; teeth about three in number, irregular, small, acute at the end; *tooth-papillæ* in two series, irregular, not numerous. *Arms* 5, three and a half times as long as the diameter of the disk, slender: *lower arm-plates*, with the exception of a few near the oral end, clothed with a thin skin, and consequently rather indistinct; they appear to be very small, about as long as broad, outer and inner edges arched, the lateral margins very slightly convex; the first plates are situated between the adoral shields, are of the same size, and with them form a continuous ring around the mouth: *upper arm-plates* naked, minutely granulated, two or three times as broad as long, frequently fractured into two or more pieces, and hence more

or less irregular in form; the outer edge is either straightish, slightly convex, or undulating: *side arm-plates* in the form of narrow ridges: *arm-spines* very short, covered with skin at the base, naked and minutely prickly at the tips; four in number, except near the disk, where a few plates are armed with five; the three upper ones are subequal, and only a little more than a millimetre in length, the lowermost one very minute, and situated in a line with the tentacle-pores; and a few of them towards the end of the rays are armed with a minute hook or double hook at the extremity. No *tentacle-scale. Genital* rimæ furnished with a distinct irregular elongate-oval plate at the outer extremity, extending a little beyond the actual opening into the disk. The general colour of the disk above is purplish brown, somewhat paler on the keels of the radial shields, considerably paler beneath; arms light brown above and whitish below; the oral and aboral shields are of the same tint as the lower surface of the disk; the skin covering the arm-spines is purplish brown, giving the arms a bordered aspect.

Diameter of disk 25 millims., length of arm about 80, length of radial shields 10.

LIII.—*Remarks on some new* Alphei, *with a Synopsis of the North-American Species.* By W. N. Lockington.

The North-American species of the old genus *Alpheus* are now known to be very numerous, as many as sixteen having been found upon the Pacific coast, from Panama northwards, making a total of eighteen species from both coasts.

Some kind of subdivision, in so numerous a group, is necessary for the sake of convenience; and the presence or absence of a rostrum and of ocular spines probably furnish characters as reliable as any.

Dana, in 1852, availed himself of the absence of a rostrum, and the inversion of the hands, to separate the genus *Betæus*, which has been generally acknowledged until Kingsley, in his synopsis of North-American species of the genus *Alpheus* (Bull. U.S. Geol. & Geogr. Surv. vol. iv. no. 1, p. 189), proposed, on what appear to me to be insufficient grounds, to reunite them.

In a large series of *A. minus*, Say, that author found many which wanted the rostrum; while in some other *Alphei* the dactylus works obliquely or horizontally, showing an approach to the characters of *Betæus*.

But is it not the case with almost every genus except such as stand alone, forming of themselves a family or subfamily, that some of the less typical species intergrade with an adjoining genus, or even with three or four adjoining genera? What is a genus? Is it not, like a species or family, a portion of the scale of Nature marked off arbitrarily for convenience in classification?

If there are rigid genera, not intergrading with others, it is because the connecting links have not yet been discovered—or because the causes which produced the generic characters were sudden and profound, destroying all races which did not change with sufficient swiftness.

The multiplicity of genera with one species has been caused in great part by the too great subdivision which has been indulged in by naturalists. Characters merely specific have been made generic, while every slight variation of form or colour has added a species. More advanced modern naturalists, reviewing these co-called species with ample material, have proved that they are merely geographical varieties of the same species; and the result has been that we have numerous single species with a full binomial to themselves, yet with little to warrant such distinction. This is especially the case among the birds of North America; and will occur in other classes as soon as our knowledge is sufficiently advanced to detect the intergradation of allied forms from different localities.

Were the test of geographical variation applied to our North-American *Alphei*, I have little doubt that many would sink into varieties. Yet the forms actually distinct are really numerous, and the genus so large that it needs subdivision. Many of the species included in it, were they classified on the same principles with birds, would become genera.

Previous to my notice of *A. bellimanus*, *A. æquidactylus*, and *B. longidactylus* (in the Proc. Cal. Acad. vol. vii. part 1, pp. 34, 35) no species had been described from this coast; immediately afterwards I added two other species; Kingsley (Bull. U.S. Geol. and Geogr. Surv. vol. iv. no. 1, p. 189) adds six new species, all occurring at Panama, and notes the occurrence of the Atlantic *A. heterochelis* at Panama and Realejo, on the Pacific coast; and in this paper I describe four additional species, noting also the occurrence of *A. heterochelis* on both shores of Lower California.

I am not aware that commensalism has previously been observed in this genus (Van Beneden, in his 'Animal Parasites and Messmates,' does not mention it), although *Pontonia*, an allied genus, is commensal; yet one at least of the Pacific species, *B. æquimanus*, is a commensal under the mantle

of the common "abalone" (*Haliotis rufescens*, Swains.). As this mollusk extends far towards the north, we may expect to hear of *B. æquimanus* from more northern localities. At present it is known only from Catalina Island and Santa Barbara, California.

As I have not in my possession any foreign species of the genus, and have not seen several of the species lately described by Kingsley, I shall in this place separate *Betæus* only, and treat of the rest of the group as one genus, divided into sections by the characters of the front and hands, for convenience in future identification.

The letter **P** indicates that the species belongs to, or has been found upon, the Pacific coast, while **A** indicates the Atlantic species.

The species I have had an opportunity to examine are marked thus, !.

Synopsis of the North-American Alphei.

A. Rostrum present.

a. Ocular spines present

A sulcus between eye-shields and rostrum: larger hand complexly sulcated, with a superior and an external spine; dactylus swollen at the tip, working horizontally: smaller hand with a superior spine. Meral joints of posterior pairs with a spine below; propodi spinulose .... *A. clamator* ! **P.**

No sulcus between eye-shields and rostrum: larger hand as in *clamator*; dactylus laminate, closing horizontally: smaller hand with superior and exterior spines. No spines on meral joints of posterior pairs; propodi spinulose.................... *A. bellimanus* ! **P.**

No spine on basal joint of antennæ: larger hand with superior and external spines, sulcate; dactylus vertical (?): smaller hand with superior spine. Posterior pairs without meral spines; propodi spinulose .... *A. barbara* *, **P.**

Antennal scale regularly elliptical; larger hand a third longer than carapax, with a spine above and a smaller one near it. Propodi of posterior pairs spinulose .... *A. minor* ! **A.**

Basal spine of antennulæ reaching to end of second joint of antennular peduncle; smaller hand (?) without spines. Penult. joint of abdomen with lateral spines.... *A. æquidactylus* ! **P.**

Orbital spines arising from superior surface of carapax, margin continuous beneath them; larger hand spineless; smaller

* = *A. clamator*, Kingsley.

ditto, slender. Propodal joints of posterior pairs spinulose .... *A. panamensis*, P.

Larger hand elongate, spineless, slightly sulcate; smaller slender, spineless. No spines or spinules on posterior pairs. Two pairs of spinules on telson .... *A. tenuimanus* ! P.

Basal spine of antennulæ reaching to middle of second joint of peduncle; basal joint of antennæ with a small upper and large lower spine; larger hand without spines or sulci; smaller ditto. Posterior pairs without meral spines; propodi spinulose. *A. læviusculus* ! P.

b. No ocular spines.

Eye-shields produced forwards, scarcely spiniform; larger hand spineless, sulcate, thumb distorted, smaller (?) .... *A sulcatus*, P.

Rostrum separated from ocular shields by a deep depression: larger hand once and a half as long as carapax, spineless, constricted; dactylus slightly oblique, with large basal tooth: smaller hand spineless; fingers about equal to palm. Posterior pairs with spinulose propodi.. *A. heterochelis* ! A, P.

Rostrum separated from eye-shields by a sulcus: larger hand with a superior spine, sulcate; dactylus as in *heterochelis*, but obtuse: smaller hand as in *heterochelis*.. *A. affinis*, P.

Carina of rostrum running back to nearly middle of carapax; larger hand once and a half as long as carapax, spineless; smaller hand as long as larger, spineless, fingers longer than palm .... *A. floridanus*, A.

Carina of rostrum continued backwards, but no depression between eye-shields and rostrum: larger hand spineless, sulcate; dactylus vertical: smaller hand spineless. Meral joints of posterior pairs spineless; propodi spinulose. Telson with two pairs of spinules above and a third pair at tip .... *A. spinicaudus* ! P.

Hands small, nearly equal; larger spineless, constricted on margins; smaller slender, fingers equal to palm. No meral spines on posterior pairs.................... *A. parvimanus*, P.

Hands very unequal; larger spineless, cylindrical, tapering; smaller smooth, slender, cylindrical, dactylus as long as palm. No meral spines on posterior pairs; propodi spinulose .... *A. fasciatus* ! P.

Rostrum very short, obtuse; no spine on basal joint of antennæ. Larger hand cylindrical, grooved externally: dactylus horizontal: smaller hand cylindrical; fingers equal to palm .... *A. cylindricus*, P.

B. Rostrum wanting; dactylus on lower side of hand. = *Betæus*, Dana.

Front emarginate between eyes; hands nearly

equal, compressed-ovate, spineless. Dactyli of posterior pairs spinulose .... *B. æquimanus*! P.
Front rounded; hands similar, fingers gaping widely .... *B. longidactylus*! P.

Alpheus clamator, Lockington.

Alpheus clamator, Lockington, Proc. Cal. Acad. Sci. vii. 1876, p. 43.
Alpheus transverso-dactylus, Kingsley, *loc. cit* p. 197.

Carapax smooth, body not greatly compressed. Front trispinose; the rostrum longer and more slender than the ocular spines, which are separated from it by a deep sulcus, and widen out quickly into the eye-shield.

Basal spine of antennulæ shorter than the first joint of the peduncle; outer branch of flagella stout, margined with setæ, about equal in length to peduncle, inner branch about half the length of the body.

Antennæ with a spine on basal joint. Antennal scale narrow; its spine nearly, and its laminar portion quite, reaching the end of the antennary peduncle, which is slightly longer than that of antennulæ. Flagella more than three quarters the length of body.

External maxillipeds extending slightly beyond peduncle of antennæ. Meros of both hands of first pair smooth, compressed, with a slender spine at distal extremity above. Carpus of smaller hand slightly longer than that of larger. Hands unequal, dissimilar. Fingers of smaller pair straight, parallel, slender, closely fitting, working vertically, about equal in length to palm; mânus with a spine above articulation of dactylus, whole inner surface beset with long hairs. Larger hand smooth proximally, setose and complexly sulcate distally. A large spine on the outer side continued backward as a carina, above the carina a deep sulcus; a second spine at articulation of dactylus. A deep and wide sulcus commencing above the articulation of the dactylus, flanked internally by a sharp ridge, externally by a smooth, broad ridge separating it from the exterior sulcus. This superior sulcus is continued obliquely backwards along the upper surface of the hand; and from about the centre of its length a transverse constriction is continued down the inner side of the hand. Below the exterior spine a constriction divides the pollex from the palm. Dactylus short, curved so as to close horizontally, swollen at the extremity, extending beyond the pollex. Ischium and meros of second pair equal; carpus five-jointed, first four joints together equal to meros, third and fourth joints each half the length of the second, which is equal to the first; fifth joint intermediate in length between

second and third; hand as long as fourth and fifth carpal joints.

Meral joint of posterior pairs with a spine at distal extremity beneath; propodal joints of all three posterior pairs spinulose beneath.

Telson broad, rounded at extremity.

Length 1·05 inch.

Colour, in alcohol, a light flesh tint, much deeper on the large hand. A darker spot on the upper surface of the carapax, also on the anterior edge of the first two abdominal segments.

This species lives in pools on rocky reefs at low-tide level, and is capable of producing, by clapping together the fingers of the larger hand, a snapping noise like that which can be made with the finger-nail.

Loc. Santa-Barbara Island (*S. A. L. Brannan*); San-Bartolomé Bay, W. coast Lower California (*W. J. Fisher*).

The above description is considerably amplified from the short and incomplete one published in the Proc. Cal. Acad. Sci.

Kingsley's description of his *A. transverso-dactylus* tallies exactly with my descriptions and with the specimen of *A. clamator* (a female) in my collection. His *A. clamator* differs from this in the want of a spine on the basal joint of the antennæ, in the proportions of the carpal joints of the second pair, in the want of a spine on the meral joints of the posterior pairs of limbs, and in the details of the hands.

A. bellimanus is near this species; but the rostrum is longer, there is no sulcus between eye-shields and rostrum; the dactylus of larger hand is not swollen at the tip, and works horizontally; the palmar portion of the smaller hand is not unlike that of the larger, and has two spines in the same positions as those on the larger; the dactylus is thin and laminate; and the meral joints of the posterior pairs have no spine below.

Alpheus bellimanus, Lock.

Alpheus bellimanus, Lock. *loc. cit.* p. 34.

Carapax slightly compressed; front three-spined, rostrum longest; no sulcus between eye-shields and rostrum; basal spine of antennulæ short, not reaching second joint of peduncle, second joint twice as long as third; inferior branch of flagella twice as long as the superior.

A small spine on basal joint of antennæ; spine of basal scale about as long as peduncle; flagella twice the length of the carapax. External maxillipeds longer than peduncles.

Feet of first pair unequal. Larger hand constricted above the hind articulation of dactylus; a longitudinal groove continued backwards from this constriction on outer side of hand for about half its length, and a second shorter sulcus running backwards close inside the upper margin of hand; a second transverse constriction posterior to the upper one, on the lower margin; from this a longitudinal sinuous sulcus is continued forward to the extremity of the pollex. A sharp spine on the distal end of the ridge separating the anterior portion of the upper outer longitudinal sulcus from the posterior portion of the lower one. A spine at articulation of dactylus. Dactylus broad, thin, and articulated, so as to close horizontally above the point of the pollex, which is very short and irregular in outline; a few long hairs on dactylus and thumb. Smaller hand compressed, constricted above and below; a spine on outer surface at base of dactylus, and a second on upper margin at articulation of dactylus; dactylus laminate, working vertically with a straight lower margin; pollex slender; distal portion of hand and inner surface of dactylus hairy.

Carpus of second pair five-jointed; first joint nearly equal to the next three; second and fifth subequal, each nearly as long as the third and fourth together.

Meral joints of remaining pairs without a spine beneath; propodi spinulose beneath.

Telson tapering, convex at extremity.

Length of larger specimen, from tip of rostrum to end of abdomen, 1·20 inch; length of larger hand half an inch, of smaller 0·38 inch.

Loc. Two specimens from San Diego, found among kelp.

The dried specimens, when comparatively fresh, have the hands beautifully coloured with spots and markings of black and white on an orange ground; and the carapax presents traces of similar coloration.

Alpheus barbara, Lock.

Alpheus clamator, Kingsley, Bull. U.S. Geol. & Geogr. Surv. vol. iv. no. 1, p. 197.

This species, supposed by Kingsley to be identical with my *A. clamator*, is proved by the absence of a spine on the basal joint of the antennæ, the different porportions of the carpal joints of the second pair, and the want of meral spines on the posterior pairs (characters belonging to parts not described in my notice of *A. clamator*) to be quite distinct from the latter; and I have therefore assigned it the name of *A. barbara*,

from the locality (Santa Barbara, California) where Kingsley's specimens were collected. The details of the hands also differ.

From *A. bellimanus* this species may be distinguished by the presence of a slender spine on the distal extremity of the meral joints of the first pair, by the want of the antennal basal spine, the less complex sulcation of the larger hand, the absence of an external spine on the smaller hand, and the equal length of the first two carpal joints of the second pair.

As Kingsley had only an imperfect specimen, and does not describe the rostrum and front, I cannot be sure that this species belongs to this section.

Alpheus minor, Say.

Alpheus minus, Say, Journ. Acad. Nat. Sci. 1818, i. p. 245; Edwards, Hist. Nat. des Crust. ii. p. 356; De Kay, New York Fauna, Crust. p. 26; Gibbes, Proc. Am. Assoc. Adv. Sci. 1851, p. 196; Kingsley, Bull. U S. Geol. & Geogr. Surv. vol iv. no. 1, p. 190.
Alpheus formosus ?, Gibbes, *loc. cit.*

Kingsley believes *A. formosus* identical with *A. minor*: the range of variation, both in size and in rostral characters, appears to be great; and as it occurs along a great length of coast, it is not unlikely that distinct geographical varieties may be made out.

Alpheus æquidactylus, Lock.

Alpheus æquidactylus, Lock. Proc. Cal. Acad. Sci. vol. vii. pt. 1, p. 35.

Front trirostrate, without sulcus between rostrum and ocular spines; the latter short, not greatly in advance of the eyes, the former extending slightly beyond first joint of antennular peduncle.

Basal spine of antennulæ stout, extending to end of second joint of antennular peduncle; joints of the latter subequal; flagella —— ?

Basal joint of antennæ with a small spine below; spine of antennal scale overpassing antennular spine by about one fourth of its length, but not extending to tip of antennular peduncle. Antennal peduncle intermediate in length between the antennular spine and that of antennal scale; flagella —— ?

External maxillipeds about equal to peduncle of antennæ.

Smaller (?) hand elongate-ovate, smooth, without spines, but with a transverse sulcus behind articulation of dactylus; a deep narrow longitudinal sulcus continuing backwards from the transverse sulcus for two thirds the length of the palmar portion: pollex with two teeth near base; tip recurved,

pointed. Dactylus articulated vertically, smooth, compressed, with a tooth near base fitting between those of the pollex; tip recurved, pointed, crossing that of pollex.

Carpal joints of posterior pairs produced into a blunt spine above distally; no spine on meral joints; propodi without spinules.

Penultimate joint of abdomen with a spine, apparently movable, at lower angle, and a triangular projection on each side of base of telson, which is smooth, somewhat tapering, convex at extremity.

Length of body 19 millims., of hand 7·5 millims.

This description is taken from a single dried, broken, and defective specimen from Monterey, California (*H. Hemphill*). The flagella of both pairs of antennæ are broken; one hand, probably the larger (?), is wanting, the other hand detached; and the second pair is wanting.

In my previous description (*loc. cit.*) I mention the larger hand; but it is probable that the member thus called is the same as that I now think, from its small size, to be the smaller hand.

Alpheus panamensis, Kingsley.

Alpheus panamensis, Kingsley, *loc. cit.* p. 192.

Loc. Acajutla, Central America, and Panama (*F. H. Bradley*).

Alpheus tenuimanus, nov. sp.

Carapax smooth, compressed, and arched in profile, much highest in centre. Front trispinose; rostrum much longer than ocular spines, reaching to middle of second joint of peduncle of antennulæ; ocular spines slender, projecting from the centre of the convex front of the eye-shields.

Basal spine of antennulæ reaching beyond the first joint of the antennular peduncle; upper branch of flagellum about as long as carapax; lower —— ?

A spine on basal joint of antennæ below; antennal scale equal to peduncle of antennæ; flagellum not shorter than abdomen.

External maxillipeds reaching beyond the antennal scale, with long hairs at tip.

Hands equal in length, not greatly differing in size, dissimilar.

Meros of first pair compressed, somewhat triangular, rounded above, with a small spine above at distal end. Larger hand elongated, entirely smooth, rounded above and below; proxi-

mal extremity slightly broader than distal; a shallow sulcus, with a shorter one above, extending obliquely upwards from the carpal articulation on the inner side of the hand; dactylus short, smooth, compressed, semicircular in outline when viewed from the side, slightly overpassing the pollex, working vertically, and closing in groove in pollex, bright red at tip (in alcohol). Smaller hand with meros similar to larger; manus exceedingly elongated, smooth, cylindrical; dactylus almost as long as palmar portion of hand, slightly curved, working vertically, slightly overpassing the long and slender pollex. Both dactyli are somewhat setose on their opposed outer margins.

Ischium and meros of second pair about equal; carpus with five joints, the first joint about equal to the next three united, second slightly longer than the third and fourth, which are equal; fifth, palmar portion of hand, and dactylus about equal, and each about equal to the second joint.

Posterior pairs without spines or spinules on any of the joints.

Telson elongate, slightly tapering, with four spinules, in two pairs, on its upper surface, and a spine on each side of its convex truncate extremity, which is margined by long setæ.

Length 34 millims.; length of larger hand 10, of carapax 13 to tip of rostrum.

A single specimen, with the antennæ and antennulæ damaged, from Port Escondido, Gulf of California (*W. J. Fisher*), is my only example of this species, which may easily be distinguished from its congeners by its long rostrum, smooth hands of equal length, and especially by the two pairs of spinules upon the telson.

Alpheus læviusculus, nov. sp.

Carapax stout, not compressed. Front trispinose, the ocular spines triangular, almost equal in length to the triangular rostrum, which is not divided from the eye-shields by a sulcus. Basal spine of antennulæ stout, reaching to the middle of the second joint of the peduncle; inferior branch of flagella two thirds longer than superior, which only slightly exceeds the peduncle in length.

Basal joint of antennæ with two spines, the upper one small, the lower almost half the length of the spine of the antennal scale, which does not reach to the end of the peduncle; flagellum short, reaching, when extended, slightly beyond the larger hand.

First pair very unequal in size. Meros of smaller hand compressed, with a spine at the upper distal end; hand about

equal in length to meros, smooth, ovate; dactylus in the same plane with the hand; pollex slightly hooked at tip.

Meros of larger hand less compressed than that of smaller; a small spine at upper distal end; manus broad, stout, entirely smooth, ovate, terminating abruptly in a sinuate distal margin, from the lowest point of which projects the short, broad, spoon-shaped pollex. Dactylus short, stout, curved, overpassing the pollex, with a large basal tooth fitting into a groove in the latter. Dactylus and pollex of both hands blue, becoming black at the tips. Meros of second pair longer than the ischium; carpus five-jointed, first joint nearly as long as the other four; second, third, and fourth joints equal, and two of them equal to the fourth; hand about equal to third and fourth joints.

Meral joints of posterior pairs without spines; propodi spinulose beneath; dactyli bifid at tip, the upper spine longer than the lower.

Telson with sinuate margins, arcuate posteriorly.

Length of largest specimen 30 millims., carapax 10, larger hand to tip of dactylus 11. ♀.

Several specimens from Port Escondido, Mulege Bay, and other points on the Californian shore of the Gulf of California.

Alpheus sulcatus, Kingsley.

Alpheus sulcatus, Kingsley, *loc. cit.* p. 193.

Bay of Panama. Zorritas, Peru (*F. H. Bradley*).

Alpheus heterochelis, Say.

Alpheus heterochelis, Say, Journ. Acad. Nat. Sci. 1818, p. 243; Edwards, Hist. Nat. des Crust. tome ii. p. 356; De Kay, New-York Fauna, Crust. p. 26; Gibbes, Proc. Am. Assoc. Adv. Sci. p. 196; Kingsley, *loc. cit.* p. 194; Smith, Trans. Conn. Acad ii. pp. 23, [illegible]
Alpheus armillatus, Edwards, *op. cit.* ii. p. 354.
Alpheus lutarius, Saussure, Crust. Nouv. des Antilles et du Mexique, p. 45, pl. iii. f. 24, 25; Martens, Wiegmann's Archiv fur Naturgeschichte, 1872, p. 139.
Halopsyche lutaria, Saussure, Rev. Zool. 1857, p. 100 (*teste* Saussure).
Halopsyche bispinosus ?, Streets, Proc. Ac. Nat. Sci. Phil. 1871, p. 242.

This appears to be one of those forms, occasionally met with in every zoological class, that have changed so slightly in accommodating themselves to their environment as to be at once recognizable as the same species.

Specimens collected in various localities in Lower California present no appreciable difference from the typical *heterochelis*, of which I have a specimen from Folrida. This specimen lacks the smaller hand.

Kingsley (*loc. cit.*) says of the smaller hand:—"cylindrical, constrictions but faintly indicated; fingers three fourths as long as palm."

In my specimens the dactylus is about equal in length to the palmar portion of hand behind it, and there is a projection, almost amounting to a blunt spine, on the inner side at origin of dactylus. There is no spine at the distal end of the meral joints of the posterior pairs, which have the propodi spinulose beneath.

The interior of the hands becomes more hirsute with age, many of the smaller specimens having only a few hairs on the fingers, while in some of the larger the distal portion of the hand is densely hairy.

The larger individuals, on examination after only a few weeks' exposure to alcohol, showed traces of a varied coloration; the tips of the fingers were black.

Length of a large specimen 37 millims. A specimen 30 millims. long has the larger hand 15 millims.

Kingsley gives the following localities:—

Fort Macon, N. C. (*Dr. H. C. Yarrow*); Smyrna and Key West, Fla. (*A. S. Packard, Jun.*); Lake Harney, Fla.; Bahama Islands (*G. B. Goode*); Bermuda Islands (*G. B. Goode*); Aspinwall (*J. A. M'Niel*); Abrolhos, Brazil (*C. F. Hartt*); Panama (*F. H. Bradley*); Realejo, W. C. Nicaragua (*J. A. M'Niel*).

I have specimens from La Paz; San-José Island, Amortiguado Bay; Mulege Bay and Port Escondido: all on the gulf coast of Lower California. Also from Magdalena Bay, west coast of Lower California.

Alpheus affinis, Kingsley.

Alpheus affinis, Kingsley, *loc. cit.* p. 195.

This appears to be very near indeed to *A. heterochelis*.

Loc. Panama (*F. H. Bradley*).

Alpheus floridanus, Kingsley.

Alpheus floridanus, Kingsley, *loc. cit.* p. 193.

Loc. Fort Jefferson, Florida (*Lieut. Jacques, U.S.N.*).

Alpheus spinicaudus, nov. sp.

Rostrum very short, continued backwards between the eye-shields as a low carina; no ocular spines.

Spine at base of antennulæ nearly as long as basal joint of peduncle; second joint of peduncle one half longer than third,

which is about equal to first; outer branch of flagellum, including its slender terminal portion, nearly equal to inner, which is about equal to carapax.

Spine of antennal scale longer than laminar portion or than peduncle of antennulæ, and equal to antennal peduncle; flagellum twice the length of the carapax.

External maxillipeds longer than peduncle of antennæ; terminal joint margined with setæ, those at tip very long.

Meros of first pair spineless, that of smaller hand concave on outer surface.

Hands of first pair unequal, dissimilar. Larger hand compressed, smooth, constricted above and below; at about the distal third of its length a sulcus, broad at commencement, but rapidly narrowing, running backwards longitudinally at right angles to the upper constriction on both outer and inner faces. Dactylus short, working obliquely, with a stout basal tooth, closing in a deep groove in the pollex; the blunt tip of the dactylus crossing the sharp extremity of the thumb. Smaller hand rounded, smooth; dactylus half the length of palm, working vertically, and equal to the pollex; tips of dactylus and pollex sharp, curved inwards, and crossing each other. Inside of both hands setose towards distal end, especially the smaller.

Ischium and meros of second pair equal; carpus five-jointed, second joint two thirds longer than the first, and longer than third and fourth together, third and fourth equal, fifth and first about equal.

Meral joints of posterior pairs without spines; propodal joints spinulose beneath.

Telson elongate; sides tapering; end slightly convex; two pairs of spinules on the upper surface, and a third pair projecting from the extremity, which is fringed with long setæ between the posterior spinules.

Prevailing colour of specimens, after six months' exposure to alcohol, red; antennæ blue.

Length of the largest female 22 millims.; length of larger hand 8 millims.

Several specimens from Port Escondido, Gulf of Cal. (*W. J. Fisher*), collected in July to August 1876; the females loaded with ova.

Alpheus parvimanus, Kingsley.

Alpheus parvimanus, Kingsley, *loc. cit.* p. 195.

Loc. Panama (*F. H. Bradley*).

Alpheus fasciatus, nov. sp.

Small; carapax smooth; no ocular spines; eye-shields scarcely produced forwards; rostrum about equal to diameter of eye; surface between rostrum and eyes slightly depressed, but with no distinct sulcus.

Basal spine of antennulæ longer than basal joint of peduncle; joints of peduncle nearly equal in length; inner branch of flagellum twice as long as outer, and rather longer than carapax.

A small spine on basal joint of antennæ below; spine of basal scale about equal to peduncle; flagella wanting or broken in all the specimens under examination.

External maxillipeds reaching to end of basal joint of antennæ.

Meros of first pair without spine; larger hand smooth, nearly cylindrical, tapering towards the dactylus, which is smooth, semicircular in profile, a fourth the length of the palm, and works vertically. Smaller hand very small, smooth, cylindrical, slender; dactylus equal to palm; pollex as long as dactylus; long hairs on inner side of fingers.

Carpus of second pair five-jointed; second joint two thirds the length of first, but equal to third and fourth together; fifth a little shorter than second. Posterior pairs with cylindrical joints; propodal joints spinulose beneath.

Telson elongate, tapering, rounded at end.

Colour after a short time in alcohol:—carapax and abdomen alternately banded with bright red and white; larger hand red, with marblings of white in some cases.

Length of a large female 18 millims.

Several specimens from Port Escondido, Gulf of Cal. (*Fisher*).

Alpheus cylindricus, Kingsley.

Alpheus cylindricus, Kingsley, *loc. cit.* p. 196.

From its short obtuse rostrum this form approaches *Betæus*. *Loc.* Pearl Island, Bay of Panama (*F. H. Bradley*).

Betæus æqualis.

Betæus equimanus, Lockington, Proc. Cal. Acad. Sci. vol. vii. p. 43.
Alpheus equalis, Kingsley, N.-Amer. Species *Alpheus*, Bulletin U.S. Geol. and Geogr. Survey, vol. iv. no. i.

Carapax smooth, compressed; front curvately emarginate between the eyes.

Outer maxillipeds as long as base of inner antennæ; setæ of terminal joint long and closely set.

Basal scale of antennulæ a slender spine, reaching beyond the middle of the second joint of the peduncle. Second joint of the peduncle nearly twice as long as the last joint; peduncle slightly shorter than that of antennæ. Outer branch of flagellum about two thirds the length of the inner.

Antennal scale with long slender spine, the laminate portion reaching about to end of peduncle. Antennæ without spine on basal joint; flagellum more than half the length of body.

"Meros of first pair trigonal, with small spine at upper distal angle."

Hands nearly equal, entirely smooth, compressed, ovate; dactylus with a sharp recurved point and a straight edge, margined with setæ; this is opposed to a similar straight edge, margined with setæ, on the pollex, which also ends in a sharp incurved point. The dactylus of both hands has a basal tooth. The fingers gape slightly at the proximal end.

Feet of second pair slenderer than third and fourth, but not greatly longer; "ischium slightly shorter than meros; carpus five-jointed: first joint as long as the three succeeding ones; second, third, and fourth equal; fifth slightly longer. Chela about as long as the two preceding joints.

"Dactyli of posterior pairs spinulose at tip.

"Telson slender, tapering; extremity regularly rounded."

Length of larger specimen 1·05 inch.

Two specimens examined, both females with ova; Catalina Island, Cal. (*S. A. L. Brannan*).

This species lives under the mantle of *Haliotis rufescens*, Swains.

Colour, when fresh, dark purple; in alcohol, a light flesh tint.

I have here supplemented the short description given in the Proc. Cal. Acad. Sci., with others taken from Kingsley's description of *A. Harfordi*, and verified by reexamination under the microscope, the previous examination having been made with hand-lens only. I cannot find the "notch furnished with two or three small teeth near the articulation of the dactylus," mentioned by Kinglsey as existing upon the pollex of the larger hand; perhaps his specimens were males.

Kingsley gives the following dimensions:—

Length. millim.	Carapax. millim.	Larger hand. millim.	Larger dactylus. millim.
24·0	8·0	8·0	4·7
19·0	6·0	6·0	3·6

My reexamination of the specimens has convinced me that

Kingsley's *Alpheus Harfordi* is identical with my *B. equimanus.*

Betæus longidactylus.

Betæus longidactylus, Lockington, Proc. Cal. Acad. Sci. vol. vii. p. 35.
Alpheus longidactylus, Kingsley, *loc. cit.* p. 198.

Carapax smooth, much compressed, "front rounded; antennular spines slender, acute. First and second antennular joints subequal, third shorter; inner flagellum three fourths the length of carapax; outer ——?

"Antennal scales shorter than peduncles of either pair of antennæ.

"External maxillipeds extending nearly to extremity of antennal peduncle."

Hands of first pair similar, long and compressed; pollex forming half the length of the manus; dactylus more than half that length; the fingers when closed gape widely, both are pointed at the end, and the points cross each other like the mandibles of a *Loxia*. At the base of the dactylus are several teeth opposed to two large ones on the manus, which also bears a large tooth in the centre of the pollex.

"Carpus of second pair five-jointed; first joint as long as the three following; second, third, and fourth equal; fifth slightly longer.

"Extremity of telson rounded."

Colour of carapax of dried specimen green, with nuances of russet and olive. Fingers of the larger hand light red, the tips green. Length of carapax 1·12 inch, of larger hand 0·56, of smaller 0·36.

As in the description of the previous species, the portions within quotation marks are from Kingsley. The single specimen in the museum of the Academy came from a sandy mud flat, San Diego, California, between tide-marks.

San Francisco, April 4, 1878.

LIV.—*Descriptions of two Butterflies collected by Dr. Turner at Port Moresby, New Guinea.* By Arthur G. Butler, F.L.S. &c.

Danais Turneri, n. sp.

♂ ♀. Dark olive-brown, with semihyaline pale green markings, almost as in *D. purpurata*, but differing as follows:—primaries with three small spots, instead of two large ones and a dot, across the end of the cell; the four spots just

beyond the cell of double the size; the spots of the forked discal series of nearly equal size throughout and continued to the interno-median interspace near anal angle; a series of six minute white dots near the outer margin: secondaries with no spot between the first and second median branches, and the spot between the radial and the third median branch truncated at the end; abdominal area with the ground-colour pale brown. Expanse of wings 3 inches 2 lines.

More falcate than *D. purpurata*; in some respects nearer to *D. sobrina* and *D. meganira*.

Neptis cyanifera, n. sp.

Wings above black, bluish towards the base: primaries with a semicircular blue patch about the middle of the inner margin, and a round white spot above it, surrounded by blue scales, upon the first median interspace; a white subcostal dot just beyond the cell; two subapical white discal spots placed obliquely, and a submarginal series of six white or whitish small spots: secondaries crossed before the middle by an irregular quinquefid white stripe enclosed in a rather broad blue belt; three or four bluish dots parallel to the outer margin. Wings below chocolate-brown: primaries below with all the spots white, all excepting those of the submarginal series (which contains eight small spots) pearly; an additional spot near the end of the cell: secondaries with the base broadly sordid white, crossed by a blackish bar; a pearly white belt before the middle of the wing; a submarginal series of pinky white spots and a marginal series of longitudinal pinky white dashes. Expanse of wings 2 inches 2 lines.

Allied to *N. Brebissonii*, *N. mortifacies*, and *N. lactaria*.

LV.—*On the* Nauplius *Stage of Prawns.* By Dr. Fritz Müller *.

After the appearance of the essay on the metamorphosis of the Prawns †, Spence Bate expressed to me his doubts on the connexion of the young forms described by me. Properly one should never refer larvæ to definite grown-up animals unless obtained from the ova and the latter from the parent. My *Nauplii* had been caught while swimming freely in the sea, and possibly might not be the larvæ of *Penæus* at all.

* Translated from 'Zeitschrift f. wiss. Zool.' Bd. xxx. p. 163.

† Archiv für Naturgeschichte, xxix. 1, 1863, p. 8.

Alexander Agassiz has since expressed himself similarly; and I also find the same doubts repeated by Dr. Paul Meyer * in a criticism of Claus's latest work ('Investigations for the Discovery of the Genealogical Foundation of the Crustaceous System').

The development of *Nauplius*-like larvæ into Macrurous Crustacea is of such importance to the genealogy of the Crustacea that it does not seem superfluous to point out once more the reasons which induce me even now to look upon the course of development described by me as a completely assured fact. I repeat, for this reason, literally, what I wrote in October 1864 as a reply to Spence Bate's doubts.

The requirement that one should only ascribe early forms to definite parents when one has obtained them from the ova taken from the parent, seems to me to be unreasonable.

If one admitted that, it would naturally be demanded not only for the earliest forms, but, with equal justice, for all young (intermediate) forms. It would be necessary to demand for every stage either that it be reared from the ovum or preserved alive until it arrives at sexual maturity; and this condition would compel us to give up the study of the development of most marine animals. I contend that it is quite enough that we should be able to unite the terminal members of the series by a continuous chain of intervening forms so closely united that there cannot be any reasonable doubt about the connexion of any two successive forms. But the proof of the connexion of my *Nauplius* with the *Penæus*, or a genus nearly related to it, I believe to have been established in a sufficient manner.

In a journal which has only twelve plates in a year I could not, as Spence Bate has done for his memoir on the development of *Carcinus mænas*, obtain seven plates for one essay. I had therefore to limit myself to illustrating only a few of the most interesting forms out of fifty pages of drawings of the development of the prawns produced from the *Nauplius* stage.

At the same time it appeared to me unnecessary to remark that the metamorphosis of one form into the other had not been imagined, but was the result of close observation of numerous larvæ.

Only in one place there were not at my command intervening forms in abundance.

Between the *Nauplius* (pl. ii. fig. 2) and the *Zoëa* represented in fig. 4 I had only one opportunity of observing (in the same species) two intervening forms, which I mentioned—

* Jenaer Literaturzeitung, 1877, No. 16, p. 247.

an older *Nauplius* whose third pair of legs I drew in fig. 3 (in four specimens), and one younger *Zoëa.*

But as it is just against this point, and, as far as I know, against this point exclusively, *i. e.* against the relation of the *Nauplius* with the *Zoëa*, that the doubts are directed of those who cannot believe in the metamorphosis of a *Nauplius* into a long-tailed crustacean, I will once more place together the peculiarities in which the oldest *Nauplius* agrees with the youngest *Zoëa.*

In the first place, they have the same highly peculiar mode of movement, by which they are distinguished at once from all other marine Crustacea.

In the second place, they have the same colour. The two anterior pairs of limbs and the fork-like caudal extremity especially show a peculiar brown colour deepening towards the extremity, which I do not find in any other Crustacea of our sea.

In the third place, the proportional length and the whole appearance of the first two pairs of limbs are the same; only they are more distinctly articulated in the *Zoëa*, and the second pair is more profusely ciliated: instead of three hairs on the end of the inner branch, there are four. Likewise the posterior extremity of the *Zoëa* differs only in having the two branches further asunder, and in having first seven and still later eight hairs on each branch, instead of six as in the oldest *Nauplius.*

In the fourth place, from the structure of the third pair of limbs (fig. 3) of the oldest *Nauplius* it is evident that after the next change of skin it must have mandibles with an acute, prominent tooth, and a broad, transversely furrowed masticatory surface, and that the mandible must bear a dark brown, non-setigerous appendage. The youngest has such a mandible, and bears such an appendage; and it may be remarked that the *Nauplius* was observed on the 24th of January, and the *Zoëa* on the 3rd of January, when I had no idea of the significance of this appendage to the mandible. I am acquainted with no similar appendage in any other Crustacean, young or old.

In the fifth place, we see in (*i. e.* from the structure of) the oldest *Nauplius*, that the next stage of development must possess four more pairs of limbs; the youngest *Zoëa* does possess four more pairs of limbs, corresponding in form to the rudiments present in the *Nauplius.*

In the sixth place, the formation of the heart, intestines, and liver is exactly the same in the oldest *Nauplius* and youngest *Zoëa.*

In the seventh place, in the oldest *Nauplius*, on each side

near the frontal margin was seen an opaque mass of minutely granulose texture, and extending beyond it a small round tubercle. The same is observable in the youngest *Zoëa*. From this mass are developed at a later period the paired eyes; and on them the tubercle is retained as far as the *Mysis* stage (fig. 9, *o*). I know of no other Crustacean with any such tubercle.

And with all these points of resemblance, what then are the differences? That the *Zoëa* is a little larger—that the carapace, already indicated in the *Nauplius*, is well developed—that the feet present as rudiments have come into action—that a few new setæ have been added,—steps in advance, every one of which might have been predicted.

I should have supposed that these reasons would pretty well suffice to convince the most obstinate doubters. However, if my *Nauplius* be not derived from a *Penæus*, and is not to become a *Penæus*, let them tell me what possibly it can be. The child must surely have a father. Still less than to the prawns would one assign it to any other Crustacean of the Malacostracous division, whether a crab or a woodlouse. Considering that the Phyllopods are wanting in our seas, there remain but the Copepoda, with the Lernæans, and the Cirripedes, with the Rhizocephala as the possible termination of its development.

It is impossible for it to become a Cirripede or a Rhizocephalan; the formation of the heart, liver, and mandibles suffice to demonstrate this. In addition it wants the frontal horns of the Cirripede-larvæ, as well as the spines (*Zacken*) and teeth, with which the third pair of limbs of the *Nauplius* of the Cirripedes is armed. When near passing into a second developmental stage, as the *Nauplius* represented in fig. 2 (*l. c.*) is, we should see in a Cirripede or Rhizocephalan six new pairs of feet under the skin, but not four of them sprouting forth freely on the ventral surface &c. It resembles certain *Nauplius*-forms of the Copepoda much more than those of the Cirripedes. In these also there occur stages of development in which, besides the three original pairs of limbs, rudiments of four new pairs are to be seen. But I do not know from my own experience, nor can I find among the numerous figures which adorn Claus's admirable work on the Copepoda, any form of mandible which could be compared to that of our *Nauplius*. Moreover, in all the marine Copepoda except the Corycæidæ, the third pair of limbs remain a well-bristled mandibular appendage. But, apart from this, the Corycæidæ have no heart such as our *Nauplius* possesses. To this we must add that the *Nauplius* reaches the length of half a

millimetre; it should therefore be considered rather a matured Copepod than the earliest form of such a one. If it belongs to a Copepod it must spring from an unknown gigantic species of a still unknown family; and it is rather strange that this gigantic species has not once fallen into my net during the course of many years.

Itajahy, St Catherina, Brazil.
June, 1877.

LVI.—*Notes on a Collection of Japanese Sea-Fishes.* By Dr. A. Günther, F.R.S.

A collection of fishes, formed by H. Batson Joyner, Esq., at Tokei, Japan, and presented by him to the British Museum, contained an unusually great proportion of interesting species, several of which are identical with those collected during the expedition of H.M.S. 'Challenger' and noticed in Ann. & Mag. Nat. Hist. 1877, xx. p. 433, whilst a few others appear to be undescribed and will be noticed hereafter.

This collection offers additional confirmation of a fact to which I have repeatedly drawn attention in the 'Catalogue of Fishes' and on subsequent occasions, viz. that there exists the greatest similarity between the marine fauna of temperate Japan and that of the Mediterranean and adjacent parts of the Atlantic, Mr. Joyner's collection containing not less than eight species identical in both seas, viz. *Rhina squatina*, *Pteroplatea hirundo*, *Beryx splendens*, *Beryx decadactylus*, *Hoplostethus mediterraneum*, *Trachurus trachurus*, *Brama Raii*, *Exocœtus lineatus*.

Sebastes Joyneri, sp. n.

D. $\frac{13}{15}$. A. $\frac{3}{7}$. L. lat. ca. 60.

The height of the body is equal to the length of the head, and one third of the total length (without caudal); scales very thin, scarcely serrate, a little smaller above the lateral line than below it; on the upperside of the head they advance to the nostrils and cover the præorbital and maxillary. Snout short, three fourths of the diameter of the eye, which is three tenths of the length of the head, and exceeds by one third the width of the interorbital space, which is flat. Upper surface of head smooth, scarcely armed, the two occipital ridges very low and terminating in short spines; præorbital with two flat spines; præoperculum with five spines,

the second from above being the longest, and one third of the diameter of the eye; operculum with two spines, the upper of which is the longest. Teeth in narrow villiform bands, in the jaws, on the vomerine and palatine bones; the vomerine teeth form a triangular patch. The maxillary does not reach to the vertical from the middle of the eye. The fourth dorsal spine is the longest, twice and a quarter in the length of the head. Anal spines stronger than those of the dorsal, the second anal spine being shorter than the third dorsal. Probably red (in life), with five brown cross bars on the back and the dorsal fin, the three anterior ones descending a little below the lateral line. Fins immaculate. Pharynx uncoloured.

Two specimens, 9 inches long.

Mugil Joyneri, sp. n.

D. 4 | $\frac{1}{9}$. A. $\frac{3}{8}$. L. lat. 40. L. transv. 14.

The height of the body is less than the length of the head, which is two ninths of the total (without caudal); eye small: its diameter is one seventh, the width of the interorbital space more than one third of the length of the head. Adipose eyelid none; præorbital emarginate and denticulated; snout longer than the orbit; extremity of the maxillary visible. There are eighteen scales between the snout and the origin of the spinous dorsal; no elongate scale in the axil. Dorsal fins equal in height; the spines are rather slender, the length of the first being rather more than three fourths of the postorbital part of the head; it is much nearer to the end of the snout than to the base of the caudal fin. The first two rays of the soft dorsal are scaly, the rest of the fin being devoid of scales; anal scaly anteriorly, as high as the soft dorsal, and commencing in advance of that fin. Caudal notched, one seventh of the total length. Pectoral two thirds of the length of the head. Axil without spot.

Two specimens, 12 inches long.

Cynoglossus Joyneri, sp. n.

D. 106–107. A. 79. L. lat. 85.

Three lateral lines on the left side; on the level of the end of the abdominal cavity the upper and lower lines are separated from the middle by thirteen rows of scales; four series of scales between the dorsal fin and the upper lateral line, and four between the anal and lower lateral line. No lateral line on the right side. All the scales on the left side strongly

ctenoid; those of the blind side are nearly smooth on the anterior half of the body, and more conspicuously serrate on the posterior. One nostril situated between the eyes, the other above the lip. Eyes very small, the upper slightly in advance of the lower; interorbital space equal to the width of the orbit. Snout contained twice and two thirds in the length of the head. Angle of the mouth much nearer to the end of the snout than to the hind margin of the gill-cover behind the eye. Tail not much elongate. The height of the body is two sevenths of the total length (without caudal), the length of the head two elevenths. Brownish, mottled with darker.

Two specimens, 9¾ inches long.

Harpodon microchir, sp. n.

D. 14. A. 14. V. 9.

This gigantic species of *Harpodon* differs from *H. nehereus* in having a second distinct band of palatine teeth within the first one, and in having the pectoral fin very short. The tubes of the lateral line are narrow and elongate; the basal half of the adipose fin is covered with scales. The interior of the mouth and gill-cavity is black.

A single specimen, 27 inches long.

BIBLIOGRAPHICAL NOTICE.

Thesaurus Devonico-Carboniferus: the Flora and Fauna of the Devonian and Carboniferous Periods. By J. J. Bigsby, M.D., F.R.S., &c. 4to. 447 pages. Van Voorst: London, 1878.

Nine years ago we had the pleasure of announcing the completion of Dr. Bigsby's 'Thesaurus Siluricus' *, a work of long labour and sound knowledge and of great value to the geological world. This respected and veteran geologist has now accumulated a still more ample systematic treasury of fossil genera and species, namely those of both the Devonian and the Carboniferous systems of strata in all parts of the world. He has arranged them, like those of his Silurian 'Thesaurus,' in a tabular form, showing the authorities and references for the names, and the horizons, recurrences, and localities of the fossils. He takes pleasure in mentioning that the publication of both of these great works has been aided by grants from the Royal Society.

The organic remains of the Devonian rocks, arranged in natural classification, occupy an elaborate table of 106 pages. Their localities

* Ann. & Mag. Nat. Hist. ser. 4, vol. iii. (1869) p. 314.

in America are enumerated in 2 pages; those in other regions in 5 pages. At page 17 and afterwards the American species are marked with an *accent*. The lithological and natural-history characters of the Devonian horizons, groups, or stages in different parts of the world are concisely and clearly shown in pages 114–126; and the books and authors quoted are enumerated at pages 127–135.

The CARBONIFEROUS flora and fauna, arranged (1) separately for North America on one page and for Europe on the opposite, order by order, in one Table, and (2) in a supplemental Table, similarly, for other parts of America on one hand, and for previously unmentioned regions on the other, take up pages 137–411. Two sets of *Addenda* of species and genera received by the author whilst the foregoing Tables were at press, and arranged like them, occupy 23 (414–426 *j*) pages.

Short summaries of the Carboniferous stratal groups (1st, in America; 2nd, in Europe, Asiatic Russia, Bear Island and Spitzbergen, the Punjaub, and Queensland) are given in 4 pages; and the authors quoted, in pp. 431–440.

A most valuable Table, giving an Analytical Conspectus of the Devonico-Carboniferous Flora and Fauna, faces page 441; and this is supplemented at page 444 with the results of the Devonian Addendum and of the Carboniferous Addenda; so that at p. 445 we find the numerical result of this conscientious and most laborious examination of the whole literature of this extensive subject. Of the whole of the Devonian and Carboniferous species known up to the date of publication, in "America" and "Europe" (that is, *Europe and the other regions* associated with it in the other lists), we see:—

Devonian Species.		Carboniferous Species.		
Common to America and Europe, &c.	Total known.	Common to America and Europe, &c.	Doubtful.	Total known.
86	4830	239	73	9171

The number of species common to these two great distinct, though allied, systems is inadvertently omitted, although the subject is entered in the Table of Contents at p. 447.

We have, however, been enabled to draw certain conclusions, which, though imperfect, are not without their use; and they will be followed up, we believe, by our indefatigable author in a forthcoming commentary on the percentage of recurrent species and other matters of interest. The total number of both Devonian and Carboniferous *species* is 14,000, divisible into about 1140 *genera*. Of these latter there are:—

In America.	In Europe, &c.	
About 12 per cent.	17 per cent.	in the Devonian only.
" 11 "	16 "	in the Devonian and Carboniferous.
" 18 "	27 "	in the Carboniferous only.

About 21 per cent. of the genera are common to the two hemispheres.

Many philosophic deductions are drawn by Dr. Bigsby from the results of his long-continued study. He notes the fewness of *species*, whether Devonian or Carboniferous, common to the two Hemispheres—in accordance, he observes, with the more or less distinct areas of deposits, possibly, in some degree, homotaxeous rather than contemporaneous. He finds, as is usually the case, that the species of the lowest organic rank are the most frequently found in widely separate countries, as Plantæ (1 in 15), Amorphozoa (1 in 8 or 10), Foraminifera (1 in 7): while the higher orders, Reptilia, Pisces, Insecta, Crinoidea, Mollusca, &c., rarely remove from their native regions, east or west. Numerous suggestive statements as to the conditions and extent of stratal groups, *constant* or *non-constant*, the mutual relations of species, their occurrence, distribution, persistency, migration, recurrence, and their natural-history standing, are given in the Introduction, pp. v–x.

In contemplating this single portion, one trace, as it were, of an exhaustless treasury of proof upon proof of Omnipotent Design, the author agrees with Hunter and Owen that "the creative force has not deserted the earth during any of the epochs of geological time that have succeeded to the first manifestation of such force, and that in respect to no one class of animals has the operation of that force been limited to one geological epoch. Perhaps the most important result of palæontological research has been the establishment of the axiom of the continuous operation of the ordained incoming of new species of living things" ('Hunter's Essays and Observations,' arranged by R. Owen, F.R.S.).

The ever-active influence of the great Presiding Mind thus consummates the Creator's great Design through the Past and the Future, which is to Him To-day; and, adds the author, "so vast and ever active is the power of conditions (that is, of the many surrounding agencies, of long periods of time, and of original impress from without), that I am well satisfied to expect from them the organic changes we observe, and without seeking further."

A well-founded hope is expressed in the Introduction that "this work will assist in opening out a new field of inquiry into what may be called 'Comparative Palæontology'"—that is, comparison of the life and conditions of geological horizons, far apart in succession, whether of wide extent or divided among limited areas.

These labours of Dr. Bigsby among the Silurian, Devonian, and Carboniferous Fossils certainly widen most extensively that field of research already commenced by Bronn (in his 'Lethæa Geognostica') and others, and enable the several students of different groups of fossils and their strata both to begin and to proceed with their work far more satisfactorily, and with far less liability to error, than heretofore. All that has been done in these several palæontological walks is elaborately catalogued and clearly expressed by our author; and the mistakes of naturalists, word-makers, copyists, and

compilers will be readily met with and corrected under the earnest eye of the competent student, who will be too thankful for the aid given him in cultivating his special field to find fault with the few weeds and stones left on its ready-prepared surface.

MISCELLANEOUS.

On the Origin and Distribution of the Turbellaria of the deep Fauna of the Lake of Geneva. By M. Duplessis.

It appears from the author's researches that all the species of Turbellaria from the bottom of the Lake of Geneva are also found (with the exception of two very remarkable species, which are at the same time the types of new genera) either in the stagnant waters of the shores, or in those of the marshes or small lakes of other parts of the canton. Nevertheless two reservations must be made in this respect: the first is, that many species which are met with in the stagnant waters of the country are not to be found in the mud of the deep waters; the second is, that the greater number of species which live also at a great depth have undergone some easily appreciable modifications.

Speaking first of the Dendrocœlous Turbellaria or Planarians, the author describes the modifications which are observed in *Dendrocœlum lacteum* and *fuscum* on comparing the individuals of the shores with those which inhabit the depths of the lake. The specimens coming from great depths are generally smaller and lighter in colour, and are further distinguished by the rosy colour of the digestive tube. The visual organ tends to become atrophied; one of these varieties of *D. lacteum* is remarkable for the division of each oculiform point into two smaller parts, and has been described by M. Gräff under the name of *Planaria quadrioculata*.

Other species, such as *Planaria gonocephala*, so common in the rivulets of the Jorat, never descend so far as the lake; and it is the same with the numerous representatives of the genus *Polycelis*.

Usually the *Planariæ* of the deep fauna appear to have emigrated from the waters of the shores; but this group is represented at the bottom of the lake by a smaller number of species.

Some very similar facts strike us in the distribution of the Rhabdocœla. *Typhloplana viridis* and *T. subfusca*, which occur everywhere in the stagnant waters of the country, are also met with in the depths of the Lake of Geneva, while *T. pellucida* and *T. pallida*, so common in the pools, have not yet been seen in the mud of the lake.

Regarding the Vorticinæ, *Mesostomum Ehrenbergii*, *lingua*, and *pusillum* are found both in the shallows and depths of the lake, while *M. personatum* appears, on the contrary, to be absent in the latter.

A curious type, *Microstomum lineare*, which is met with everywhere on the shores, descends also to the deep waters of the lake; but it there invariably becomes larger, and its intestine of a pale rose-colour similar to that of the *Planariæ*.

Lastly the Rhynchocœles or Nemertians are represented in the deep fauna by *Prostomum lineare* and *Prorhynchus stagnalis*, which are also found, the former in the pools of the shore, the latter in springs and under the stones of rivulets.

These observations are sufficient to show that the deep fauna of the Lake of Geneva has originated, at least as regards the Turbellaria, from the littoral and paludicolous species of the neighbouring regions. Yet (and this is the most remarkable point in this investigation) two species of the deep fauna completely evade this interpretation, owing to the fact that they are not found in the waters of the shores, and that, on the contrary, they resemble Mediterranean types. These two species have been provisionally described under the names of *Vortex lemani* and *Mesostomum morgiense*, and probably belong to new genera. The latter, in particular, is certainly not a true *Mesostomum*, but belongs to a family of Turbellaria hitherto exclusively marine. These two forms, without analogues in the remainder of our fauna, are at the same time those which reach the greatest depth. They have only been found in a few other European lakes—as, for instance, in that of Starnberg, in Bavaria.

The class Turbellaria is not, however, the only one which presents facts of this kind. M. Vernet has found amongst the crustaceans of the deep fauna a form related to the genus *Cythere*, which is, as is well known, exclusively marine. M. Duplessis has himself remarked amongst the Arachnida of the lake two species which bear a striking resemblance to marine types. One is the *Campognatha Forelli*, which so exactly resembles a small *Campognatha* of the Mediterranean shores, that at the first glance one might confound the two species. The other belongs to a singular genus, which also occurs in the mud of the Mediterranean. How can facts of this nature be explained? Perhaps we have here the last remains of a marine population, some types of which have accommodated themselves to fresh water as the sea retreated. This, however, is a mere conjecture; and we all know how circumspectly we must venture upon this ground.—*Bibl. Univ.* Oct. 15, 1877, *Arch. des Sciences*, p. 326.

Characters of a new Species of Dryops *from Formosa* (Coleoptera, Parnidæ). By Charles O. Waterhouse.

The British Museum has recently received a small collection of objects of natural history from the island of Formosa. They were presented by Mr. Matthew Dickson; and among the Coleoptera I find a specimen of the genus *Dryops* which belongs undoubtedly to an undescribed species. I propose to name it

Dryops Dicksoni.

D. elongatus, griseo-flavescens, sericeus; thorace parum convexo, disco medio leviter impresso, angulis posticis divergentibus, acutissimis; elytris striatis.

Long. 4 lin.

Very closely allied to *D. substriatus*; but, besides being nearly double the size, it differs in having the thorax less convex, with a slight impression on the disk, the sides are less arcuate and more distinctly margined, and the posterior angles are much more diverging. The elytra are more distinctly broader than the thorax, more evidently striated; and, lastly, the pubescence on the head and thorax is more erect and darker in colour.

Hab. Formosa.

British Museum,
May 15, 1878.

On the Organ called "Dorsal Chord" in Amphioxus lanceolatus. By MM. J. Renaut and G. Duchamp.

In the Vertebrata the tissues of the skeleton may be divided into three principal categories:—1, the primary axis, formed by the dorsal chord; 2, the cartilaginous tissue; 3, the osseous tissue. These different tissues succeed one another in the higher animals, and the definitive skeleton is formed by bone, or at least by true or calcified cartilage. At this period there only remain rare vestiges of the primary axis or dorsal chord; so that, except *Amphioxus*, we know of no Vertebrate of which the definitive skeleton is represented solely by a persistent notochord.

This organ, moreover, possesses in the series typical characters which it is necessary to refer to briefly; it is formed of globular cells, soldered to one another after the fashion of epithelia, as transparent as glass, and possessing a very distinct nucleus (usually thrown back to the periphery).

The dorsal chord of fishes does not differ fundamentally from that of the embryos of the highest Mammalia. That of *Amphioxus*, on the contrary, presents no arrangement resembling the structure just described. It is contained in a cylindrical sheath which envelops it on all sides; and, in sections made perpendicularly to the general axis of the body, after hardening in dextrine and alcohol, it proves to be constituted as follows:—

In the interior of the sheath, stretched horizontally from the left to the right side, are seen some fibres of uniform diameter, cylindrical, solid, and adhering by their extremities to the general envelope. In proportion as they approach the dorsal surface these fibres curve gently upwards, so as to circumscribe in the median line, between the sheath and the chord, an empty spindle-shaped space. On the ventral side the same arrangement is repeated in the opposite direction; so that only the fibres of the middle plane are horizontal and rectilinear.

In a longitudinal section passing through the axis of the chord and the two sides of the body the sheath is shown divided in the direction of its length; and the area thus intercepted is occupied by the fibres of the chord, which consequently offer a scalariform arrangement relatively to the two margins of the sheath.

In such a preparation, suitably coloured by means of picrocarminate of ammonia or of eosine dissolved in water, we observe the following details:—

The sheath of the notochord becomes uniformly coloured red by the carmine, without showing any nucleus either in its interior or at its outer surface; the eosine leaves it absolutely colourless. All the inner surface bristles with a multitude of little conical projections, which are continuous at their base with the hyaline substance of which the envelope is formed. These little cones remain colourless with carmine, and acquire a bright rose-colour with eosine; they do not present the appearance of nuclei, and are entirely homogeneous. At the extremity of each of them is inserted, at the same time capping it, one of the fibres of the notochord. Each fibre answers by each of its extremities to one of the projections just described; it is regularly cylindrical, contains no nucleus, and becomes coloured, like elastic tissue, yellow by the action of the picrocarminate, and bright rose by eosine.

The action of potash does not cause the breaking-up of these fibres into nucleated masses; carmine, hæmatoxyline, and the other reagents for nuclei do not reveal any in the thickness of the sheath. We are therefore justified in regarding them as non-cellular bodies, having no relation either with the characteristic tissue of the notochord or with cartilage. On the other hand they present a structure and histochemical reactions exactly analogous to those offered by the fibres which compose the axial organ of the Calamary known as the *pen*.

From what precedes, it appears that the *Amphioxus*, which is destitute of red blood containing hæmoglobine enclosed in special elements, also does not possess a dorsal chord comparable by its structure to that of all vertebrate animals. It therefore seems permissible to raise doubts as to the morphological value of its notochordal axis.—*Comptes Rendus*, April 8, 1878, p. 898.

On the Zoological Affinities of the Genus Mesites. By M. A. Milne-Edwards.

In 1838, I. Geoffroy Saint-Hilaire described a very remarkable bird from Madagascar under the name of *Mesites variegatus*. From its external characters he had great difficulty in referring it to any definite place in the system; and he remarked that it resembled the *Heliornithes* in its head, the Penelopes and Curassows in its body, and especially its wings, and the Pigeons in its feet. Some years later M. Desmurs described a somewhat different bird under the name of *Mesites unicolor* as a new species. G. R. Gray, in his 'Genera of Birds,' arranged *Mesites* in the family Megapodiidæ, close to *Leipoa*; and in this he was followed by Bonaparte, Reichenbach, and Hartlaub; but in the British-Museum Catalogue of Birds, Gray shifted the genus to the Passeres, as forming a section of the family Eupetidæ. Sundevall accepted this view; and Hartlaub, in his last work on the birds of Madagascar, placed *Mesites* after the Motacillidæ, among the Dentirostres.

All this time the only known specimens were the two originally described respectively by Geoffroy Saint-Hilaire and Desmurs: but M. A. Grandidier has recently received from Tamatava two

Mesitæ, preserved in spirits, which he has sent to M. Milne-Edwards for examination. The results of this investigation are given by the author as follows:—

"The *Mesitæ*," he says, "are neither Gallinaceæ nor Pigeons, as I. Geoffroy and Prince Charles Bonaparte thought; nor are they Passeres, as Gray, Sundevall, and Hartlaub supposed. They must occupy a place among the Grallæ, in which they form a family allied to the Rails and Herons. I cannot now dwell upon the conformation of the different parts of the skeleton and muscular system; these details will be set forth in a special memoir; and I shall confine myself here to noting that the sterno-clavicular apparatus is remarkable, and indicates only a very feeble power of flight; its characters are quite peculiar, although reminding one a little of those of certain Rails. The keel is not very prominent, and its anterior angle is carried back nearly to the middle of the sternum; the lateral plates are much reduced and cut into on each side by a deep emargination of the posterior margin. The episternal apophysis, which is very strong, very long, and carinate below, bifurcates at its apex to furnish points of attachment for the ligaments of the shoulder. *There is no trace of a furcular bone*; there is not even an osseous style like that which exists in certain nocturnal Rapacious birds, in some Parrots, and several Pigeons. The wings, which are very short, cannot enable the *Mesitæ* to sustain themselves long in the air.

"The pelvis is as remarkably broad as the sternum is narrow: we remark in it some of the characters proper to the *Eurypygæ* and Rallidæ. The feet are strong, and the toes, like those of the Blongios (*Ardea minuta*) and some other Herons, are constructed so as to be able to grasp reeds and vertical stems.

"The muscles greatly resemble those of the Rallidæ. As in the latter, we find a femoro-caudal and its accessory, a semitendinosus and its accessory, and an iliac accessory of the perforate flexor of the toes, which, starting from the ilio-pectineal apophysis, passes along the inside of the thigh and over the rotula, and is inserted upon the superficial flexor of the toes; this latter bundle is deficient in the Ardeidæ and in the Passeres. There are two carotids, as in the Rails and Herons, whilst the Passeres only possess a left carotid.

"The *Mesitæ* are also remarkable for the existence of five pairs of down-patches hidden beneath the feathers, and occupying on the dorsal surface of the body the scapular and iliac regions, and on the ventral surface the pectoral, costal, and abdominal regions. The Herons present patches of the same nature, but differently disposed. The attention of naturalists had already been called to these peculiarities by Mr. E. Bartlett.

"Lastly, I may add that the differences of form and coloration which appeared to M. Desmurs sufficient to distinguish *Mesites unicolor* from *M. variegatus* appear to me to be due to sex: in fact the female *Mesites* that we possess is exactly like *M. unicolor*, and the male has all the characters of that described by I. Geoffroy under the name of *variegatus*."—*Comptes Rendus*, April 22, 1878, p. 1029.

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END OF THE FIRST VOLUME.

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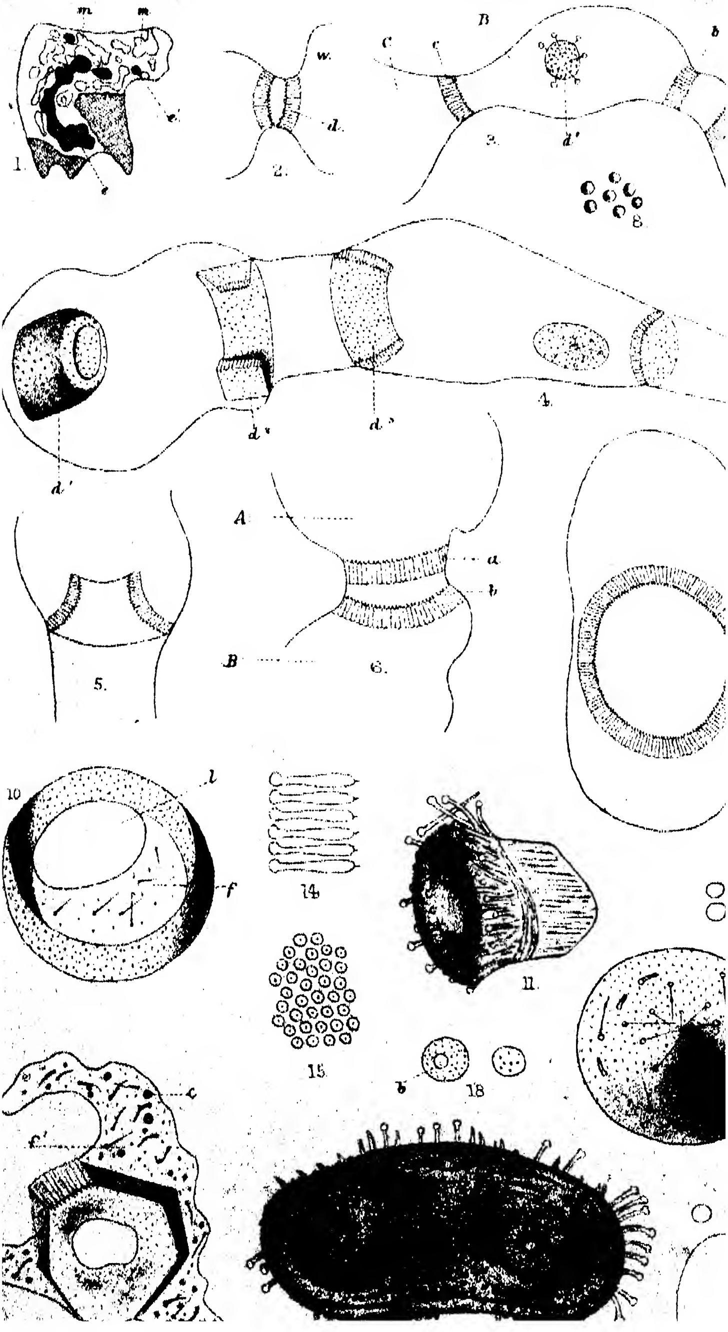
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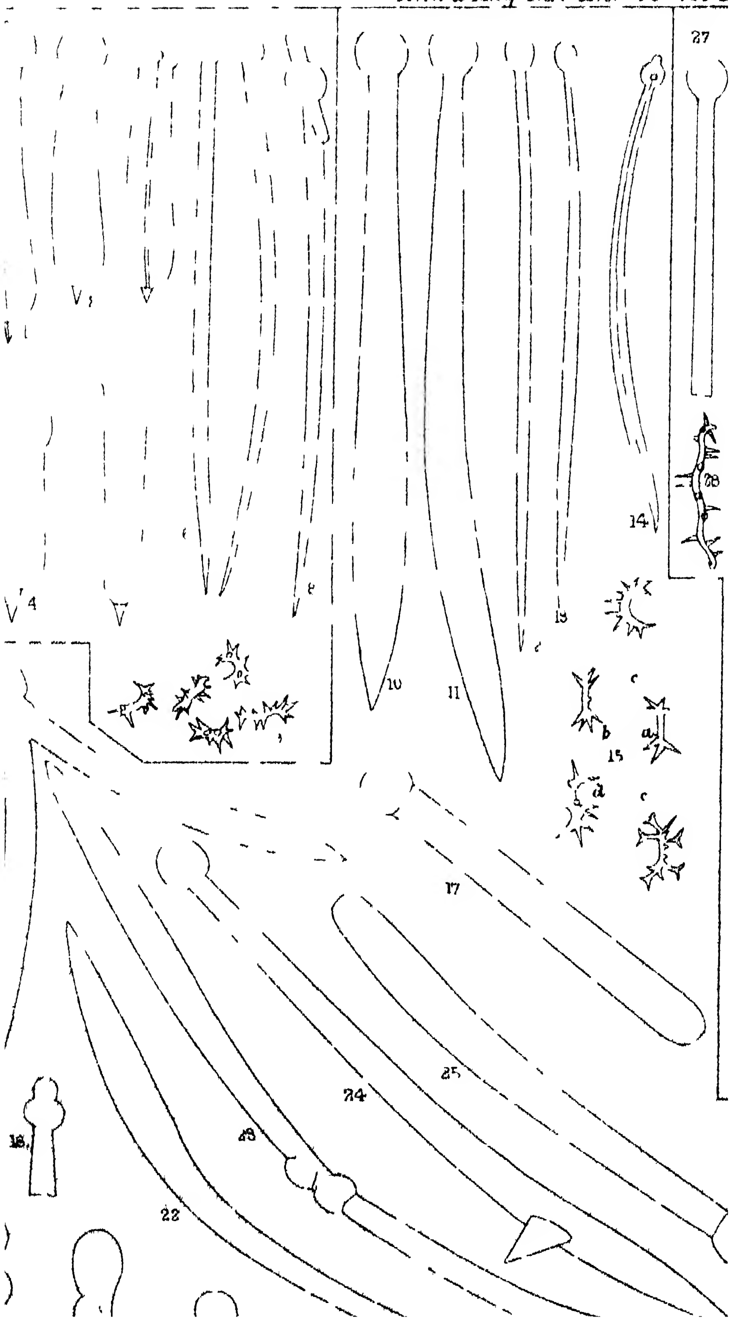
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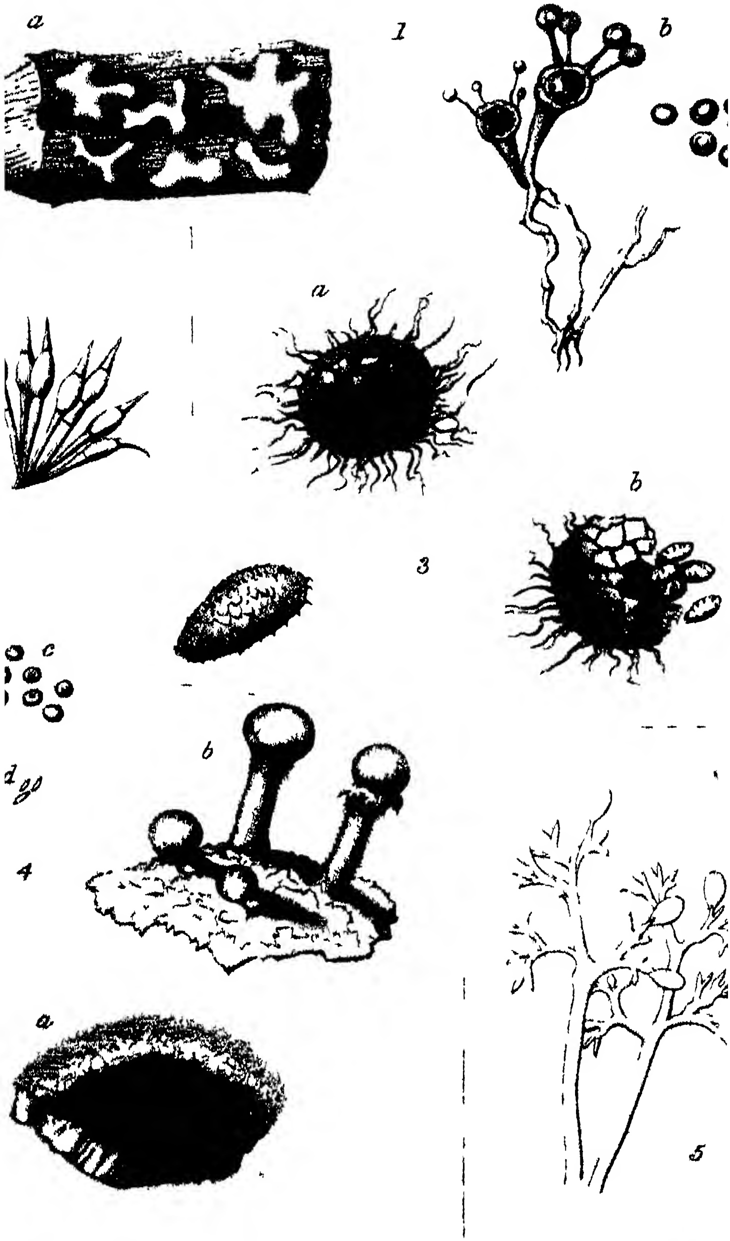

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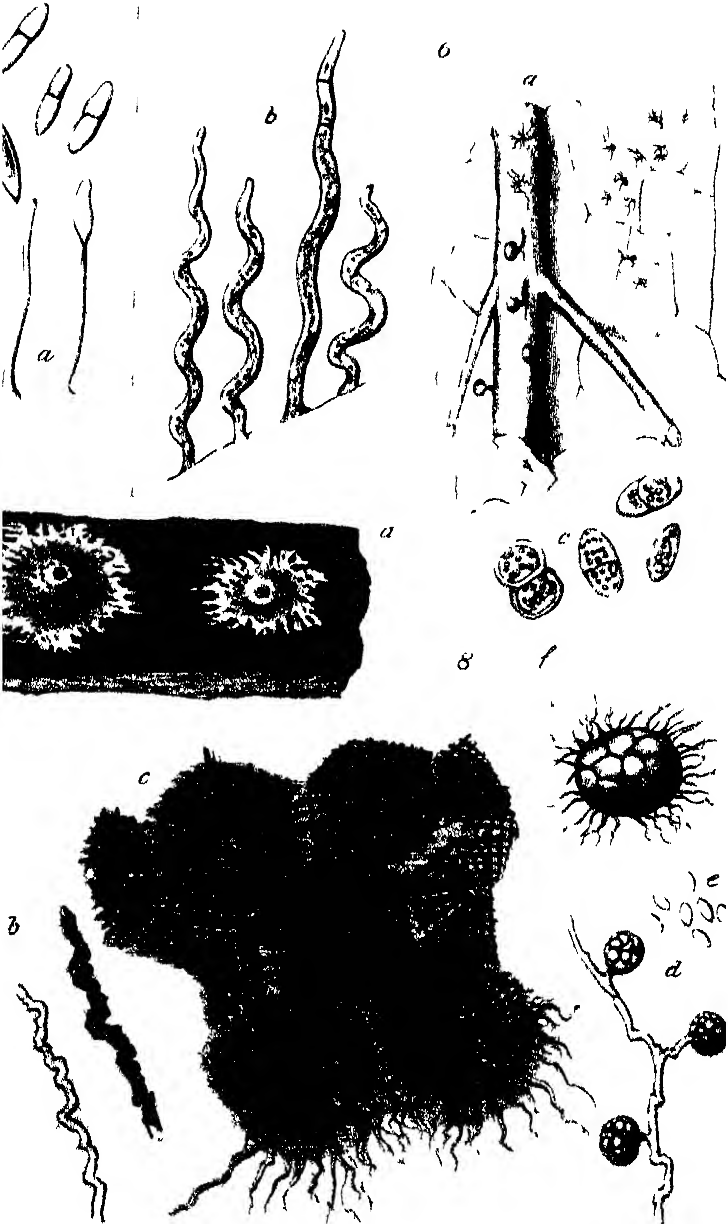

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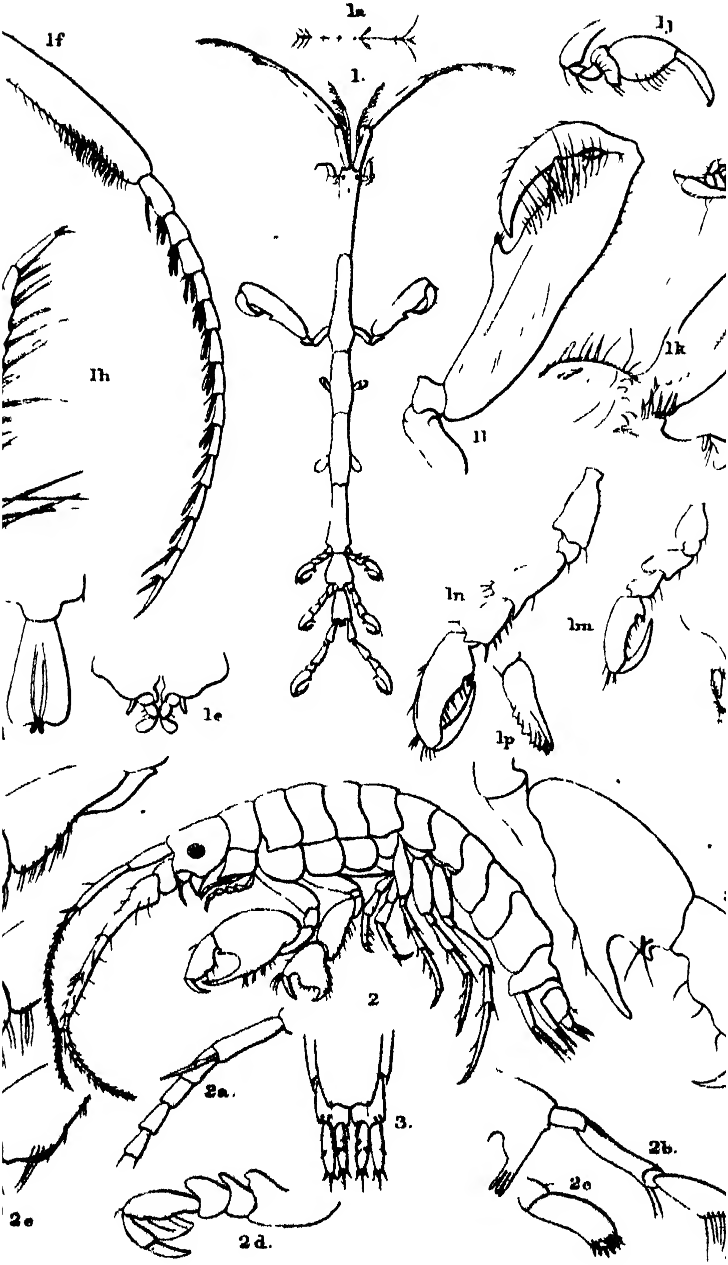
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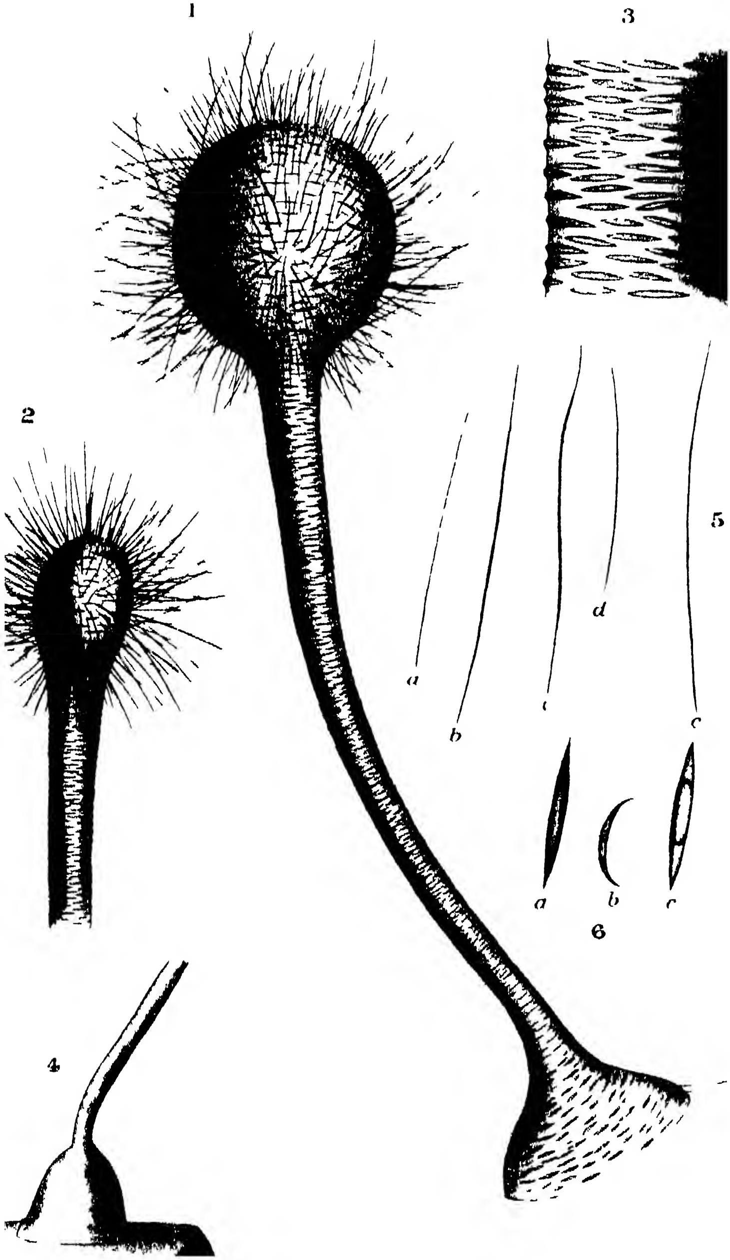
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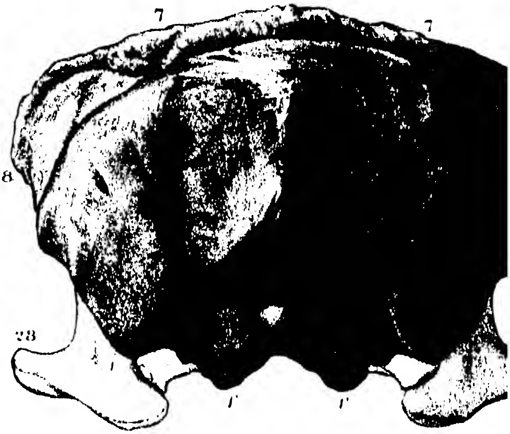

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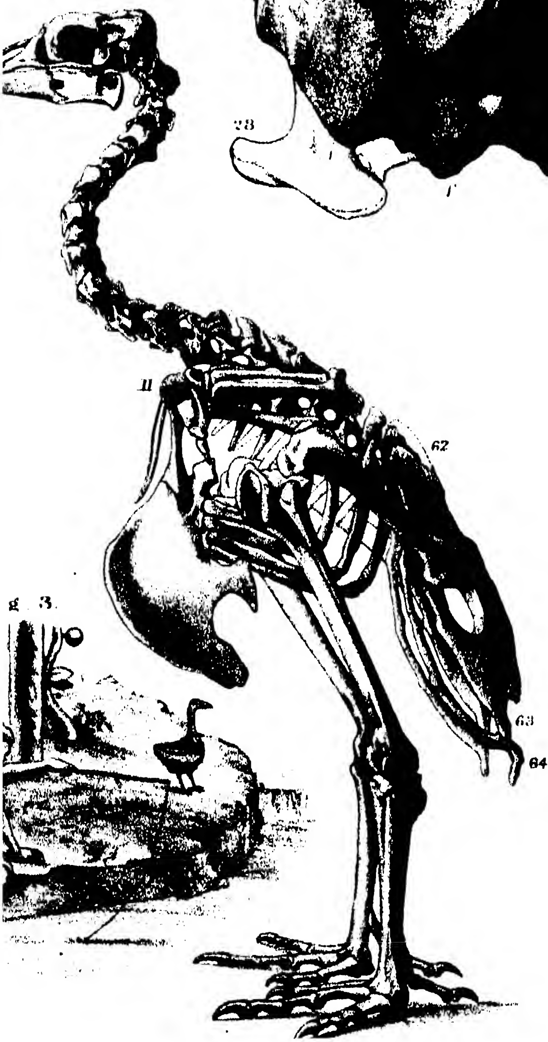

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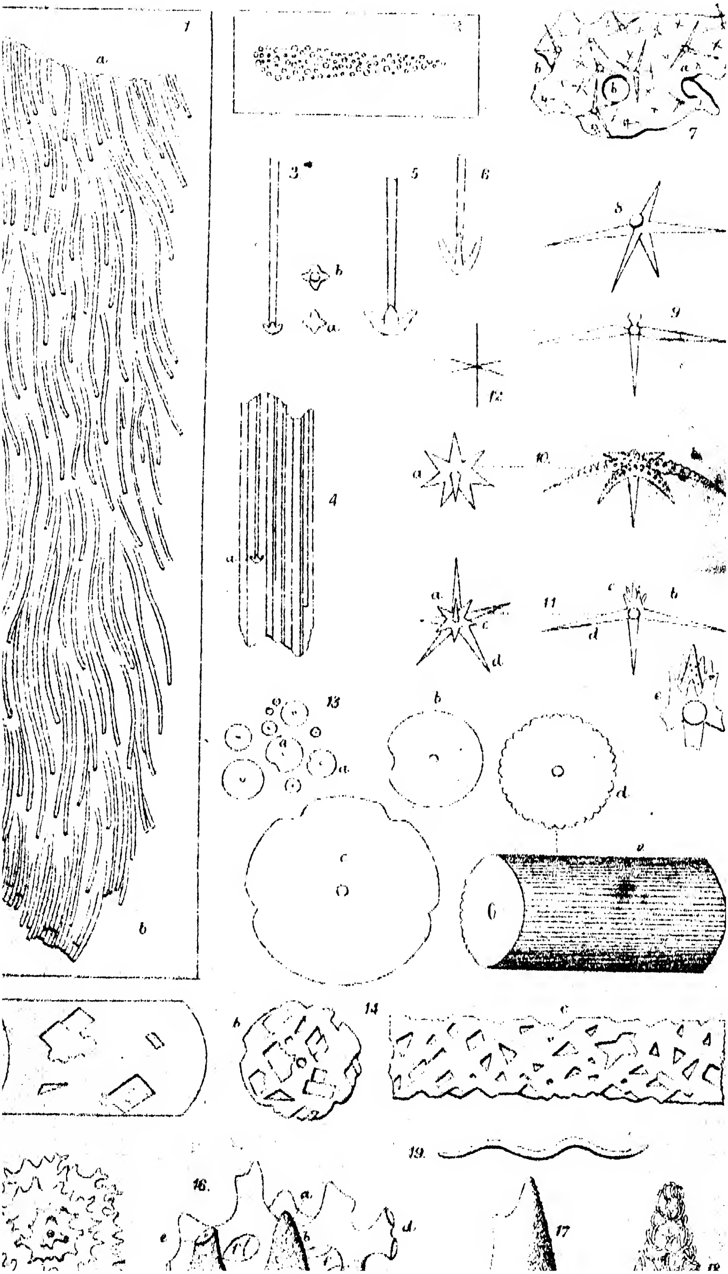
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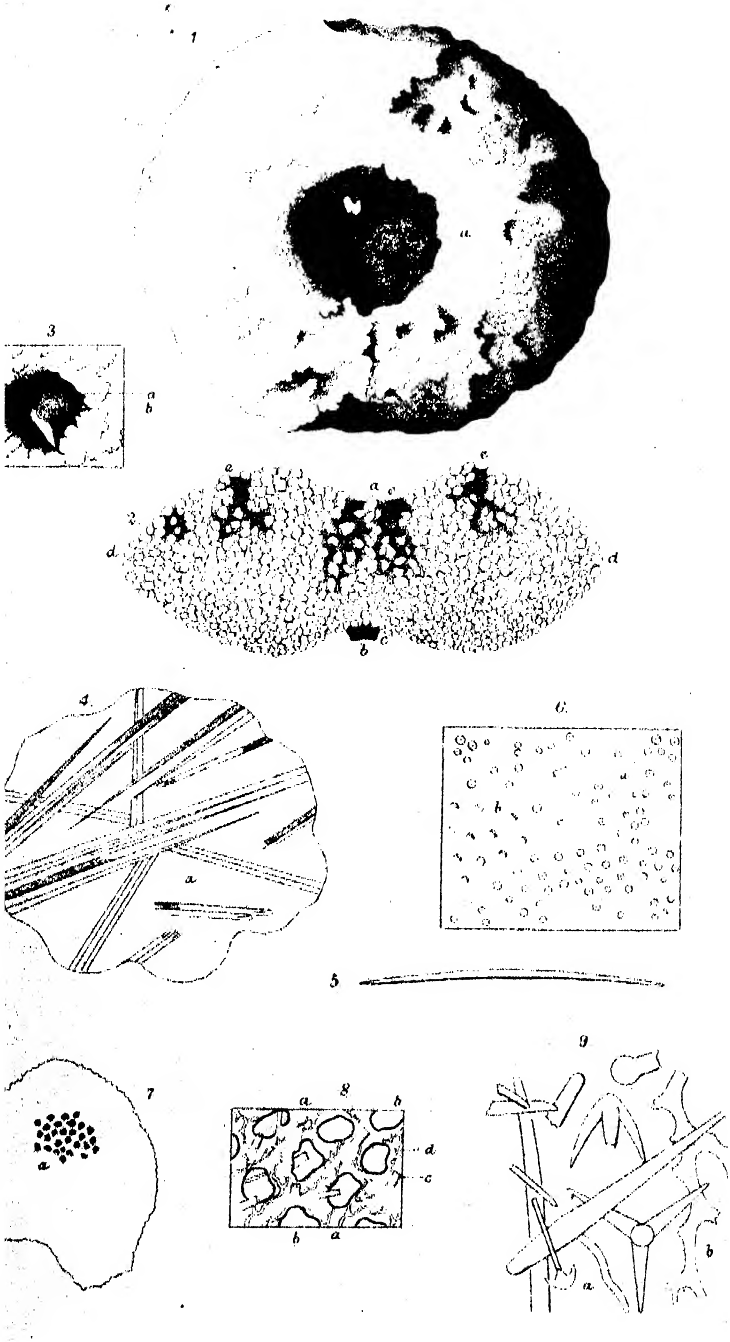

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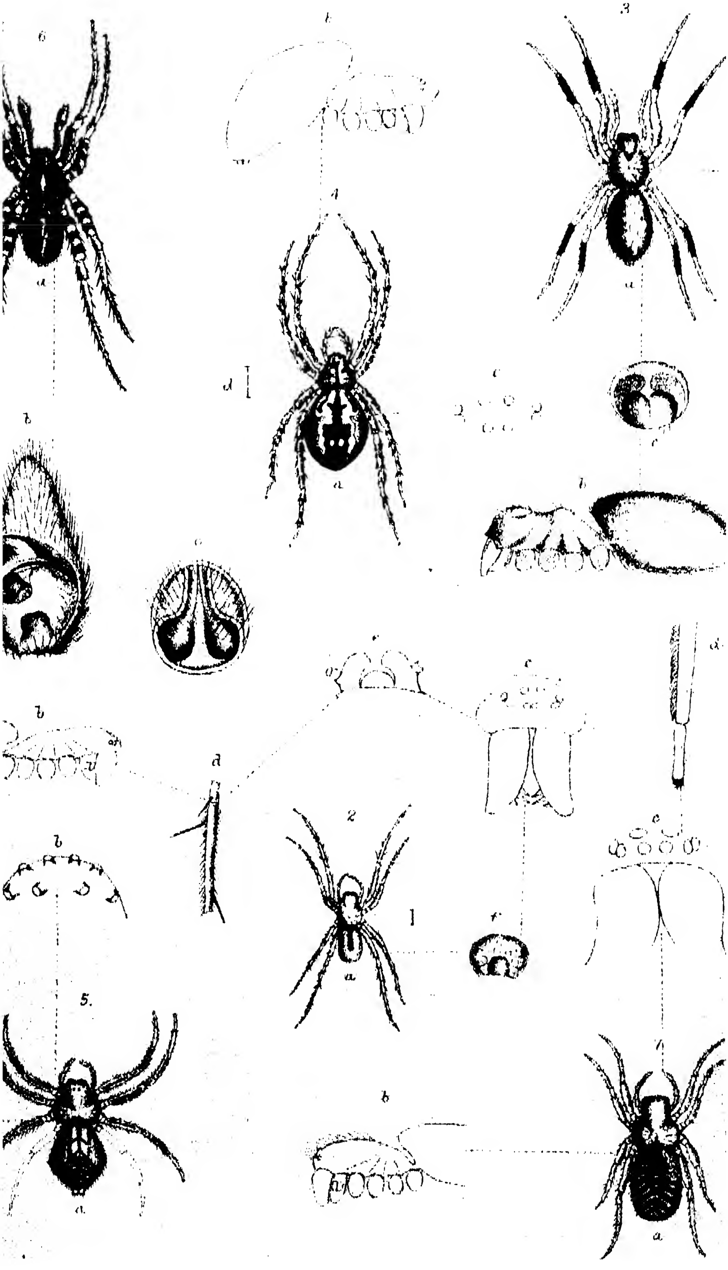
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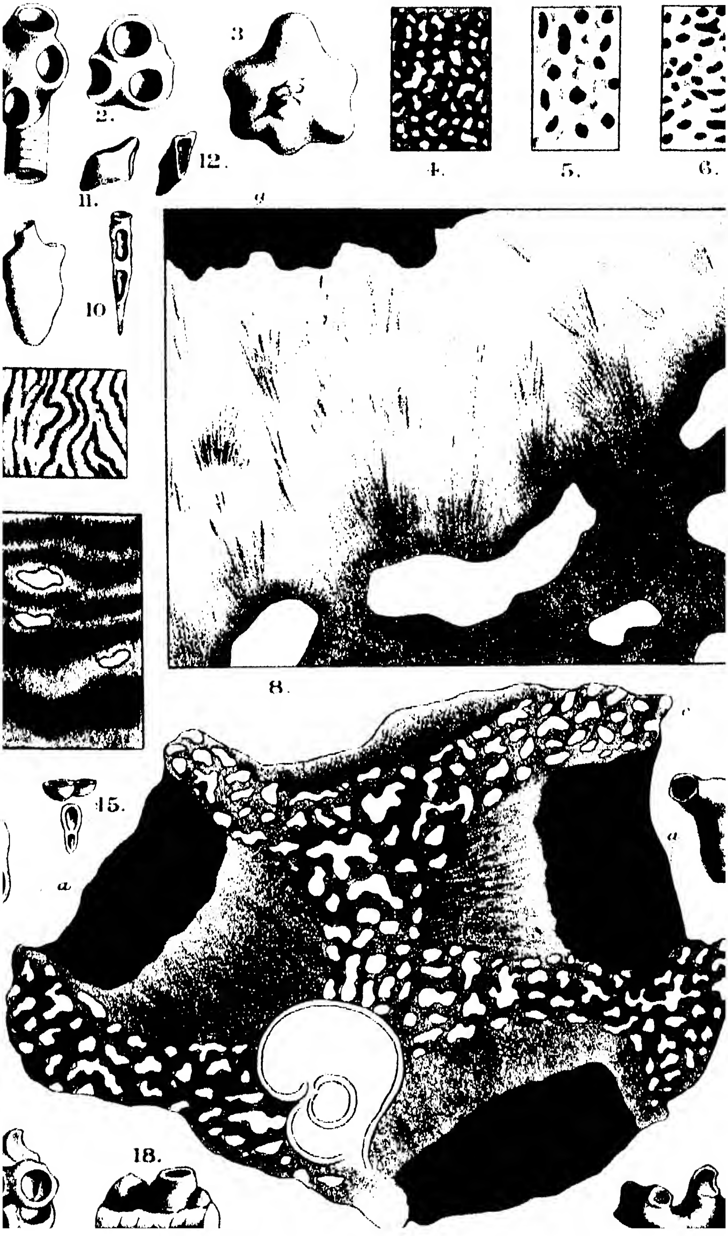
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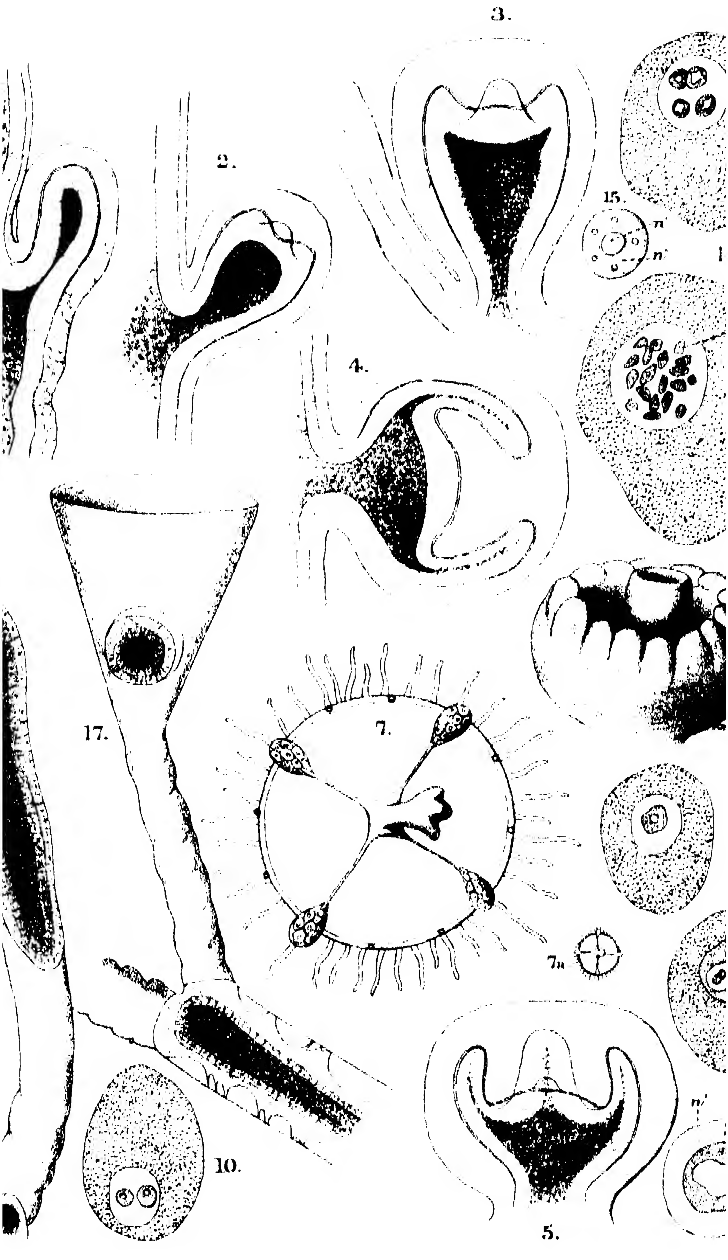
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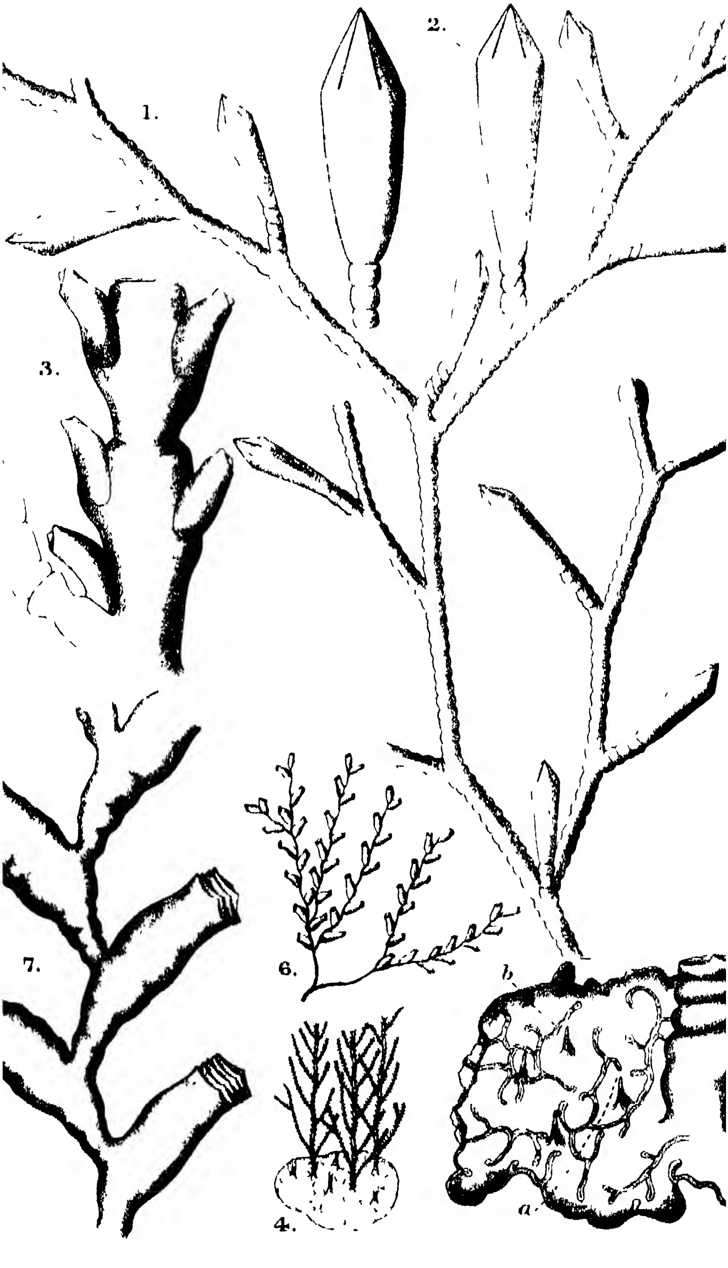
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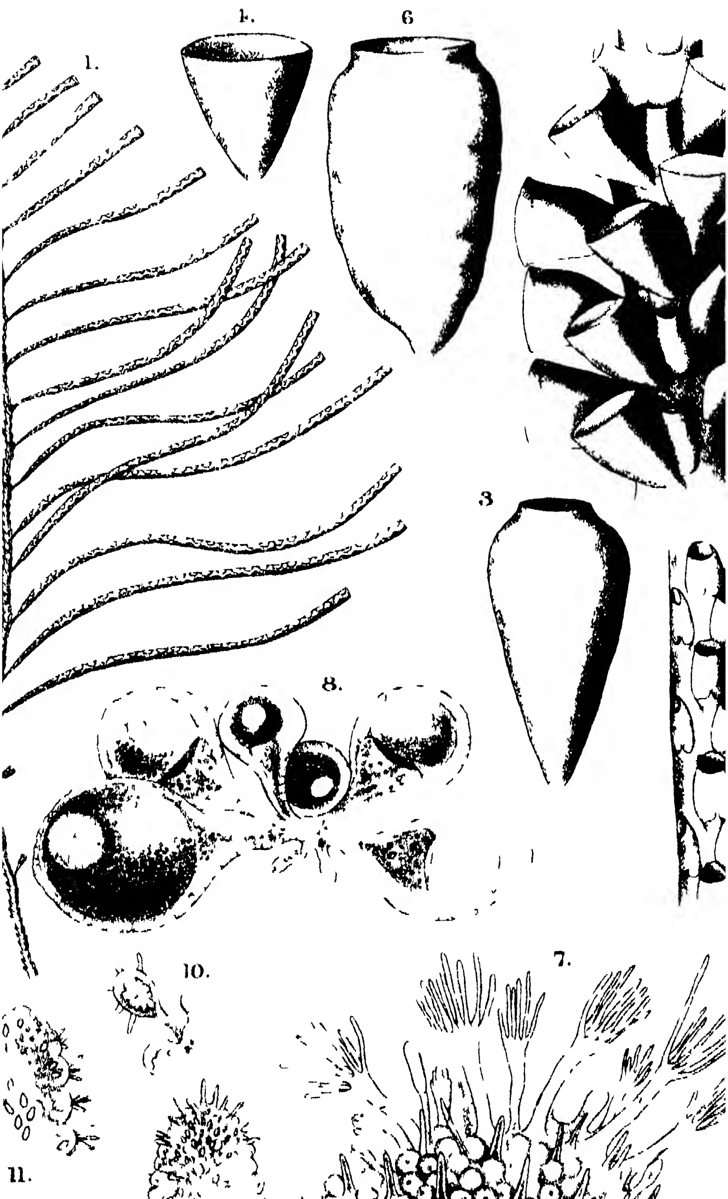
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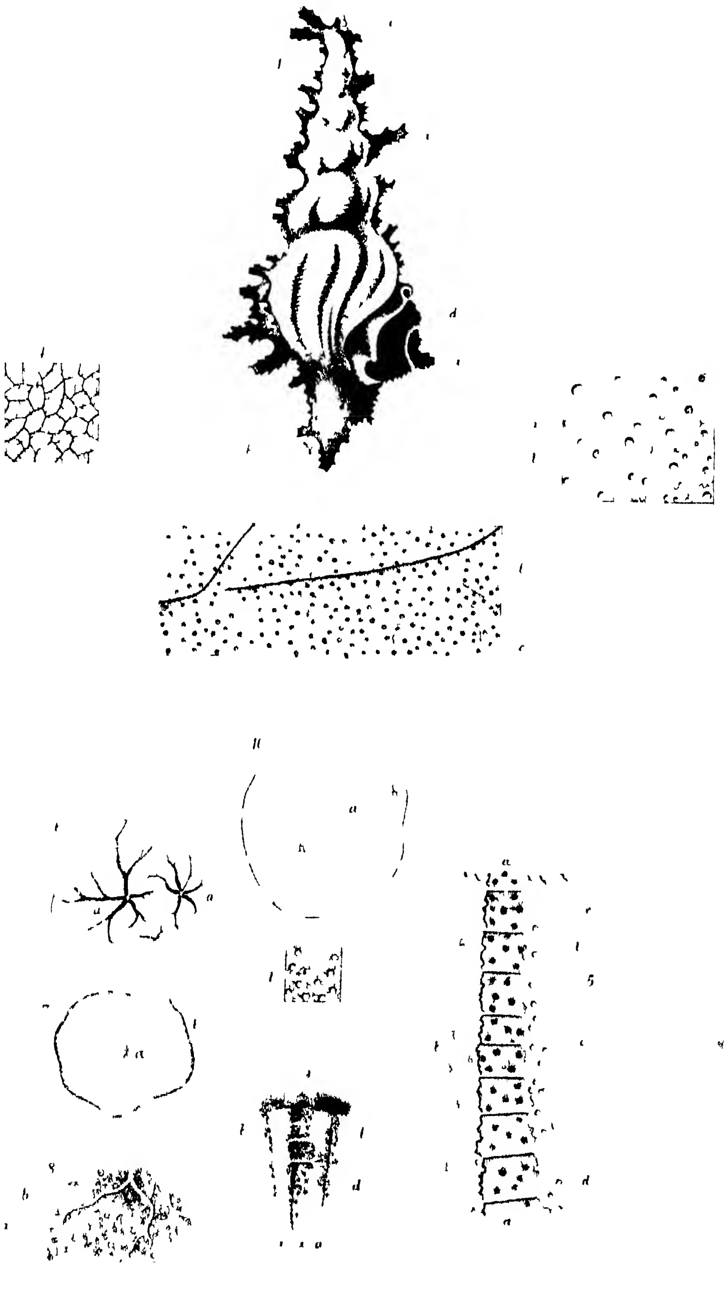

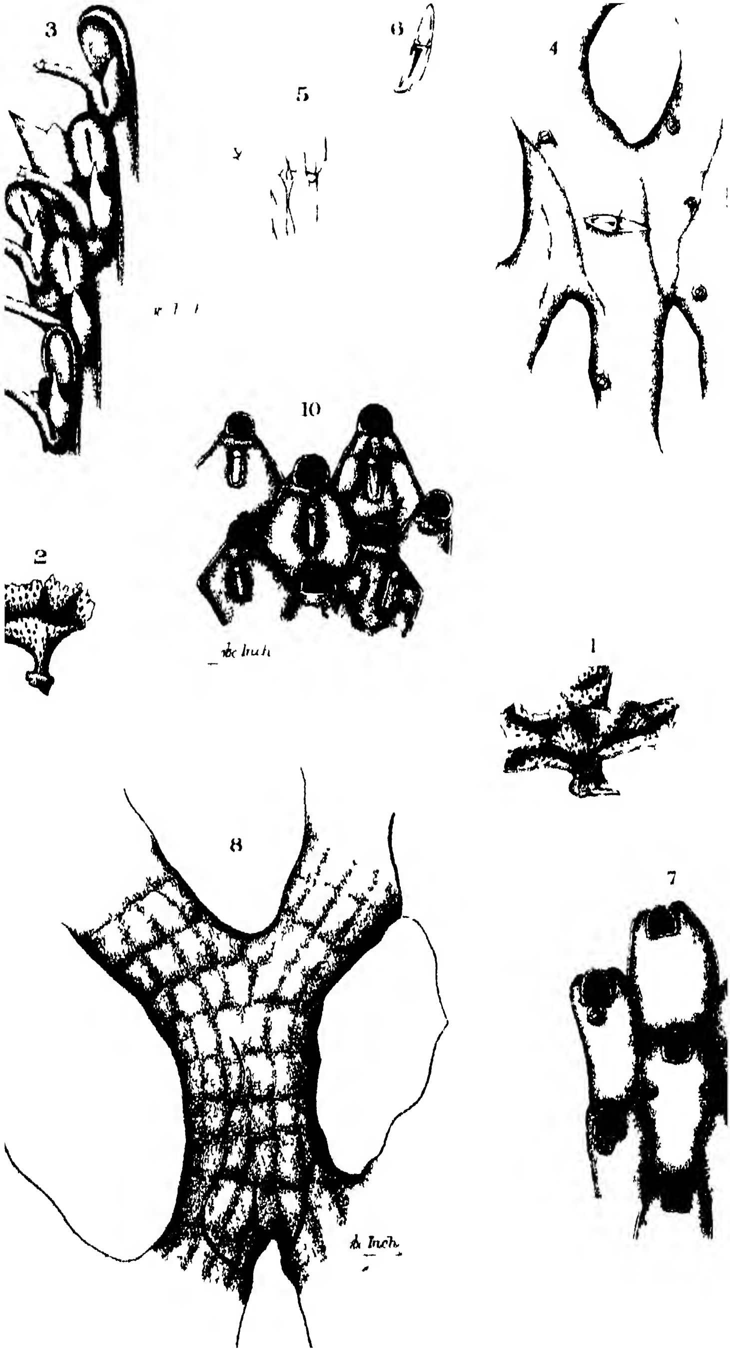

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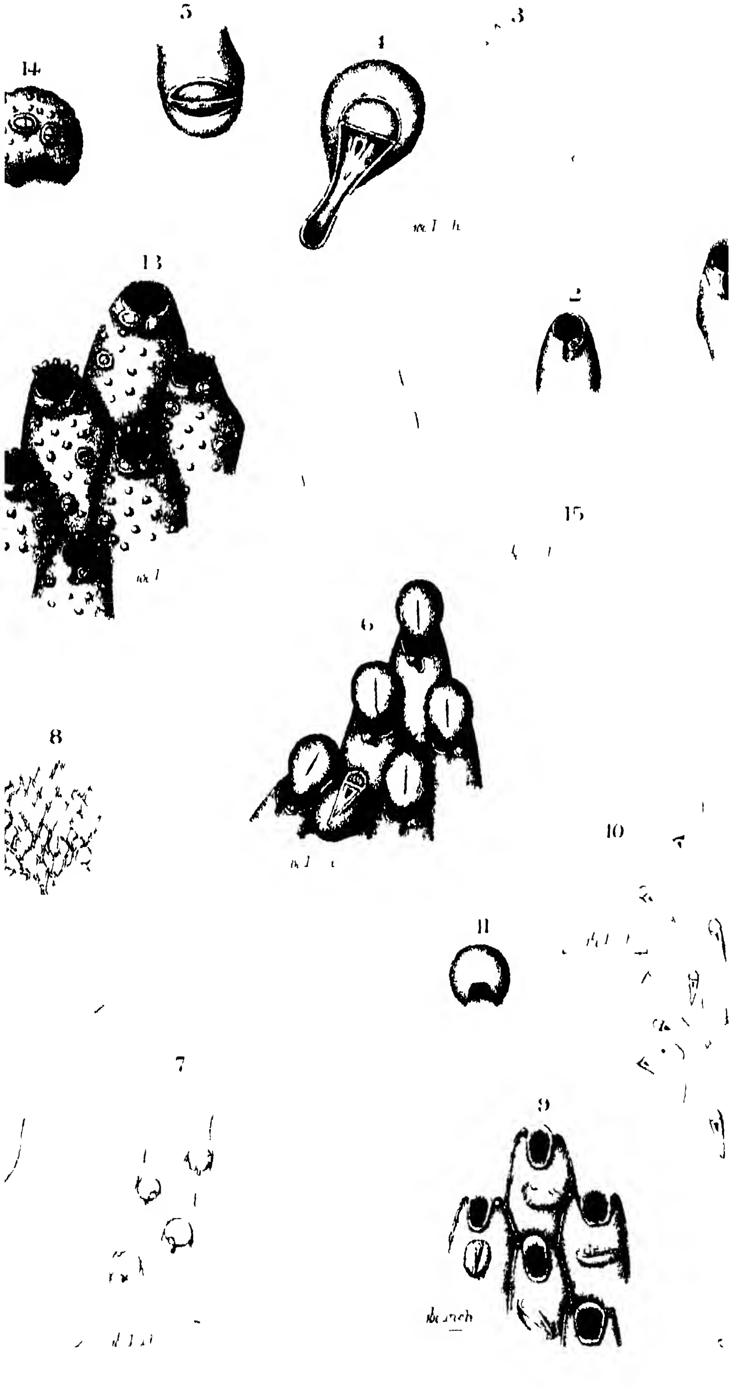

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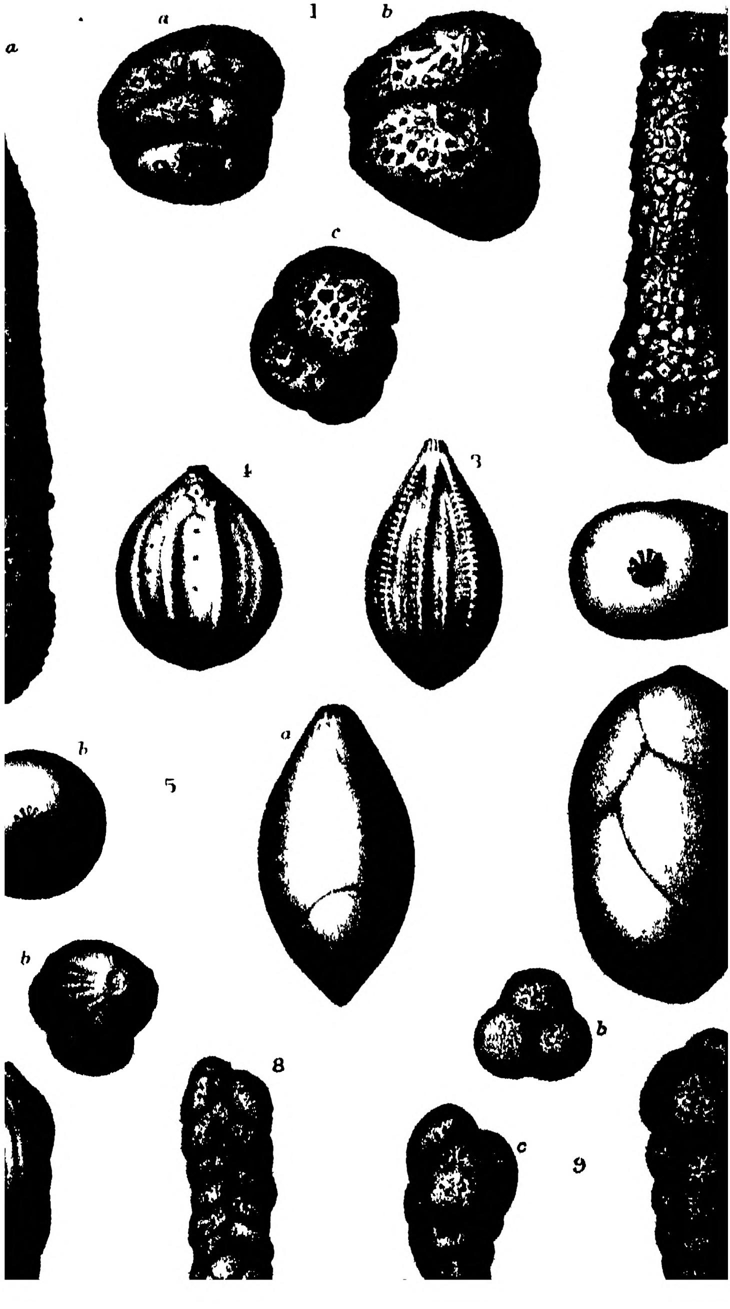
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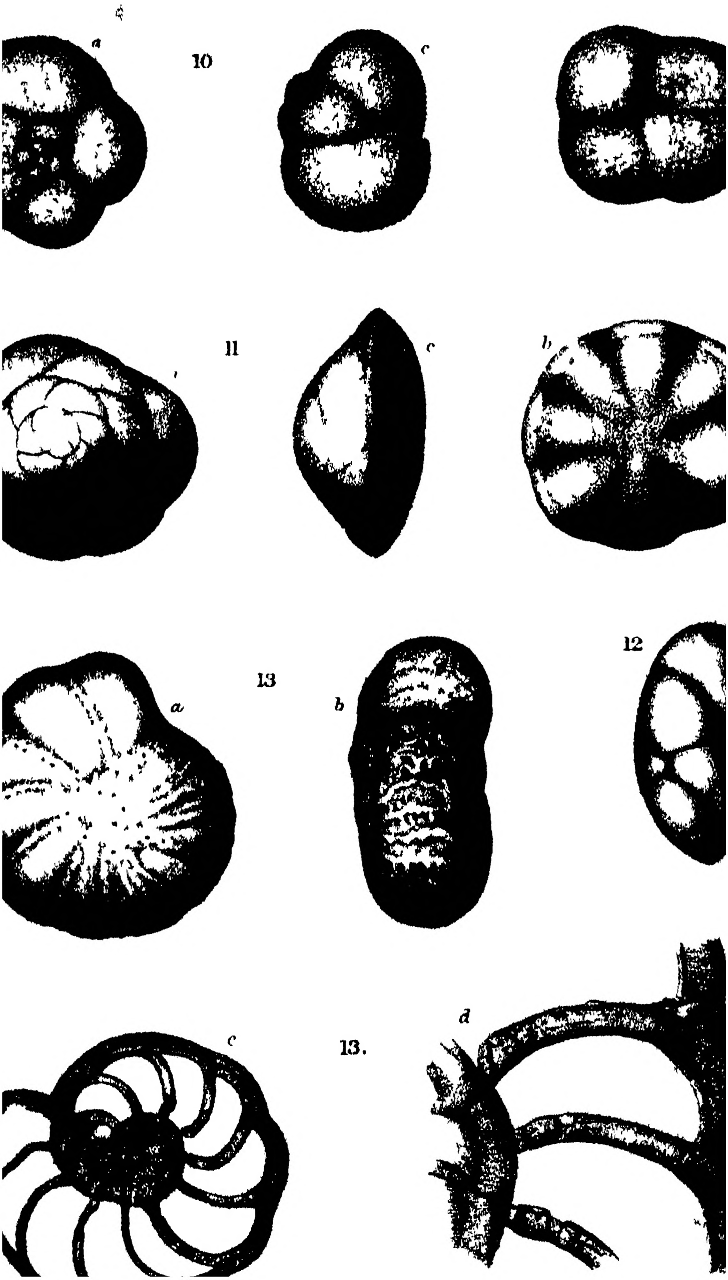
10
a
c
11
c
b
13
a
b
12
c
13.
d